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FEBRUARY, 1909

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School of Mines EDITION

FEBRUARY, 1909

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Announcement for 1909-1910

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HISTORICAL

The Legislature in the Spring of the year 1895 appropriated to the University of Pittsburgh the sum of \$50,000 for the establishment of a School of Mines in connection with the University. The Governor of the Commonwealth, the Secretary of Internal Affairs, and the Superintendent of Public Instruction are constituted an Advisory Board.

The Legislature of the Spring of the year 1907 appropriated the sum of \$175,000 for the erection of a building for the School of Mines. This building is to be completed in May, 1909, equipped during the summer and be ready for occupancy at the opening of the school year in September. This building is 84 by 59 feet with a wing 70 by 46 feet, each contains four floors, giving approximately an outside space of 32,000 square feet. An addition to this building will be erected as soon as practicable, as the present structure will not long accommodate the School of Mines.

The School of Mines was organized and began its work in 1896-97. In 1907-08 it was reorganized and its new course of instruction went into effect the present school year, 1908-9.

SPECIAL ADVANTAGES

The location of Pittsburgh, in the very heart of the bituminous coal fields of the Appalachian system, and in the most richly productive oil fields of Western Pennsylvania, with the great concentration here of the mining and metallurgical interests, make this undoubtedly the most advantageous point in which to study Mining and Metallurgy in the

United States. Some of the largest mines and smelting works in the country are accessible to the students within a few minutes' ride of the city, by rail or electric cars.

It is also conveniently located with reference to the coal fields of Ohio and West Virginia. The Pennsylvania Bituminous Coal district produced in 1907 149,559,047 tons of coal and 23,516,309 tons of coke. Within this district there are some sixteen hundred mines of which about fourteen hundred are productive and worked by seven hundred and twenty-three companies.

Amongst some of the most noted of the coal mining companies there may be mentioned: Berwind-White Coal Co., Bessemer Coke Co., Brier Hill Coke Co., Cambria Steel Co., Carnegie Coal Co., Ellsworth Coal Co., H. C. Frick Coke Co., Jamison Coal and Coke Co., Keystone Coal and Coke Co., Latrobe-Connellsville Coal and Coke Co., New York and Cleveland Gas Coal Co., Oliver and Snyder Steel Co., Penn Gas Coal Co., Pennsylvania, Beech Creek and Eastern Coal Co., Pittsburgh Coal Co., Pittsburgh and Baltimore Coal Co., Pittsburgh and Buffalo Coal Co., Pittsburgh and Eastern Coal Co., Pittsburgh Gas Coal Co., Pittsburgh and Westmoreland Coal Co., W. J. Rainey Co., Rochester and Pittsburgh Coal and Iron Co., Somerset Coal Co., United Coal Co., Vesta Coal Co., Washington Coal and Coke Co., Westmoreland Coal Co., Youghiogheny and Ohio Coal Co., Pittsburgh Plate Glass Co., etc.

The opportunities for the study of Mining in its practical sides, especially in Coal Mining, are unrivaled. Along the Metallurgical side, particularly in Iron and Steel Metallurgy, the advantages are unsurpassed.

Amongst the well known metallurgical plants there can be mentioned a few like the Carrie Furnaces, Clairton Steel Works, Clark Mills, Donora Steel Works, Duquesne Steel Works, Edgar Thomson Steel Works, Homestead Steel Works, Isabella Furnaces, Jones & Laughlin Steel Works, Lucy Furnaces, McCutcheon Mills, Monessen Mills, Painter Mills, Pittsburg Steel Works, Union Mills, and numerous others.

Within the district tributary to Pittsburgh are over 5,000 manufacturing establishments employing 350,000 men and having an annual pay roll of \$500,000,000. The city itself has some over 800 manufacturing establishments with an aggregate annual wage per man of \$660, although the average annual wage per man engaged in industrial pursuits throughout the United States is only \$475. Pittsburgh produces 63 per cent. of all the steel made in the United States, 89 per cent. of the plate glass, and holds a leading place in numerous other manufactures.

Not only has the student the advantage of the weekly excursions made to the different mines, mills, and smelting works in the vicinity, but he is daily in contact with an atmosphere replete with mining and metallurgical enterprises. He naturally draws inspiration from the busy,

bustling city with which he is surrounded and from its enthusiastic business men. The gospel of hard untiring work is preached on every side, for the School of Mines is planned only for thinking, hard working, and energetic students.

During his course the student is not only in touch with vast industries but on graduation he is in a spot where his services are most naturally in demand. During his course the young man who needs to do so can find employment during his available time in some of the over 800 manufacturing establishments in Pittsburgh or in its numerous other industrial enterprises. Nor are the moral or intellectual opportunities to be overlooked in a city containing some 400 churches and 140 schools with over 2,200 instructors and 82,000 pupils.

In addition to the excursions to the different mines and metallurgical establishments the students have the opportunity to attend meetings and lectures of all kinds like that of the American Mining Congress, the American Civic Association, and numerous other societies that meet regularly or occasionally in Pittsburgh. Further arrangements have been made for prominent mining and metallurgical engineers to give, from time to time, talks to the students of the School of Mines upon their specialties.

The School of Mines Building is near the Carnegie Institute with its geological, mineralogical, botanical, zoological, paleontological, archaeological, art, and other collections and with its immense library, all of which are available for the use of students.

The building is also located in a conveniently accessible part of the city, near the Schenley Hotel, the University Club, the Soldiers' Memorial, the Carnegie Technical Schools and adjacent to some of the beautiful residence districts of the city. It can be readily reached by steam and electric cars from almost every part of the Pittsburgh district, as it is centrally located in the city. The building is not far from the United States' Experimental Testing Station for the investigation of mine explosions and other factors relating to mining. Its work is readily available for the student.

One of the student's greatest advantages is that he is allowed to substitute for part of his elective school work, practical work done under proper conditions, in the mines, smelting works, mills, etc. All this brings the student in direct contact with the great industrial world of which he must so soon form a constituent part. It gives him not only the chance to obtain knowledge, but it also gives him the opportunity to know how to use his knowledge on his graduation, if he has properly availed himself of his advantages.

THE MINING INDUSTRIES

Throughout the State of Pennsylvania and the United States a deserved support has been freely given to advance Agricultural education, but no such support has been given to an education equally deserving of the fostering care of the State and Nation—that of educating the men who are to care for the mineral wealth of the country—men from whom there is demanded far more knowledge, skill, and care than does Agriculture, since Nature can repair the mistakes made in the latter, while it can never restore the raw material nor the precious lives which ignorant or unskilled mining has once destroyed. The mineral wealth of the State and Nation are as much their life blood as are their agricultural products, while in this State their value is shown by the census returns to be nearly thirty millions of dollars greater. The mining industries give to the husbandman markets for his farm produce almost at his own doors; while both are the chief factors in affording the raw material for the immense sum of over eleven hundred millions of dollars derived from the manufactured products of Pennsylvania.

The Census Report on Mines and Quarries states: "Pennsylvania, which ranked second in population and manufactures and eighth in agriculture was the leading mining state in 1902, both in the number of wage-earners employed and in the value of products. Its high rank was due to the production of anthracite and bituminous coal, the wage-earners reported for the coal mines forming 84.7 per cent. of the 190,935 reported for all mines in the state, and the products of such mines forming 76.9 per cent. of the total product of \$236,871,417. The position of Pennsylvania as the leading mining state was most pronounced. Out of a total of 581,728 wage-earners engaged in mining in United States, Pennsylvania reported 190,935, or 32.8 per cent., who received as wages \$114,122,437, or 30.8 per cent. of the \$369,959,960 reported as the total. The value of the State's production was equally high, being \$236,871,417, or 29.7 per cent. of the \$796,826,417 reported for the United States. Practically one-third of the whole mining industry of the United States, as measured by the persons employed and the value of the products, was confined to this state. While it is true that the exploitation of the enormous coal deposits has been responsible for Pennsylvania's position as the leading mining state and that this industry has assumed overshadowing proportions, it is also true that the State has produced a large variety of minerals. Of the 52 classes of minerals reported 23 were found in Pennsylvania, the State being exceeded in this respect only by California, with 26 classes, and by Virginia, with 24."

Below is given a table of the States arranged in the order of the relative rank of the value of their mineral product for the year 1902. It also gives for comparison the value of the agricultural and manufactured products of the different States with their population. This has been arranged from the census data, except for 1906, which has been taken from the statistics published by the United States Geological Survey.

SCHOOL OF MINES

STATES AND TERRITORIES (EXCEPT ALASKA) ARRANGED IN THE ORDER OF THE VALUE OF THEIR MINERAL PRODUCTS AND GIVING THEIR AGRICULTURAL AND MANUFACTURED PRODUCTS AND THEIR POPULATION.

| Relative standing. 1906, 1902. | | Value of Mining Products. | | Gross Value of Agricultural Products, 1900. | Net Value of Manufactured Products, 1900. | Population, 1900. |
|-----------------------------------|--------------------|---------------------------|---------------|---|---|-------------------|
| | | 1906. | 1902. | | | |
| 1-1 | Pennsylvania | \$ 657,413,780 | \$236,871,419 | \$ 207,895,600 | \$1,104,871,630 | 6,302,034 |
| 2-2 | Ohio | 209,976,930 | 57,186,922 | 257,065,826 | 523,249,207 | 4,157,545 |
| 4-3 | Michigan | 104,424,548 | 50,157,358 | 146,547,681 | 214,559,224 | 2,420,982 |
| 6-4 | West Virginia..... | 90,694,588 | 48,378,414 | 44,768,979 | 47,996,315 | 958,800 |
| 8-5 | Colorado | 69,834,581 | 40,603,286 | 33,048,576 | 84,194,085 | 538,555 |
| 3-6 | Illinois | 121,188,306 | 38,234,410 | 345,649,611 | 840,375,269 | 4,821,550 |
| 13-7 | California | 50,037,409 | 28,844,669 | 131,690,606 | 175,425,385 | 1,482,179 |
| 7-8 | Montana | 74,126,567 | 28,265,085 | 28,616,957 | 50,159,514 | 231,559 |
| 16-9 | Indiana | 34,473,776 | 28,224,760 | 204,450,196 | 257,976,214 | 2,516,462 |
| 10-10 | Minnesota | 60,865,450 | 25,729,545 | 161,217,204 | 190,314,135 | 1,741,986 |
| 12-11 | Missouri | 55,496,317 | 20,284,656 | 219,296,970 | 256,671,841 | 3,106,665 |
| 9-12 | Alabama | 65,046,153 | 17,367,992 | 91,387,409 | 60,949,630 | 1,828,697 |
| 5-13 | New York..... | 92,870,905 | 13,350,421 | 245,270,600 | 1,325,298,879 | 7,263,110 |
| 15-14 | Utah | 34,998,856 | 12,340,350 | 16,502,051 | 17,128,664 | 274,952 |
| 11-15 | Arizona | 56,365,889 | 11,197,375 | 6,997,097 | 19,294,742 | 122,931 |
| 22-16 | Kansas | 22,584,076 | 10,700,285 | 209,895,542 | 136,060,304 | 1,468,469 |
| 25-17 | Iowa | 17,347,800 | 9,676,224 | 365,411,528 | 120,479,720 | 2,231,468 |
| 17-18 | Tennessee | 27,444,570 | 9,533,782 | 106,166,440 | 77,928,247 | 2,020,616 |
| 24-19 | Kentucky | 18,758,897 | 8,533,423 | 123,266,440 | 108,325,261 | 2,147,174 |
| 21-20 | Idaho | 22,721,174 | 8,214,671 | 18,051,625 | 2,906,144 | 159,147 |
| 20-21 | Maryland | 22,939,894 | 7,313,712 | 43,823,419 | 139,056,198 | 1,188,044 |
| 28-22 | Texas | 14,751,037 | 6,981,532 | 239,823,244 | 83,639,058 | 3,048,710 |

MINING INDUSTRIES

| | | | | | | |
|-------|---------------------------|---------------|-------------|---------------|---------------|------------|
| 35-23 | South Dakota..... | 7,509,907 | 6,769,104 | 66,082,419 | 10,176,916 | 383,887 |
| 18-24 | Virginia | 24,650,814 | 6,607,807 | 86,548,545 | 96,468,277 | 1,854,184 |
| 14-25 | New Jersey..... | 39,854,697 | 6,605,402 | 43,657,529 | 355,646,950 | 1,883,669 |
| 32-26 | Vermont | 9,452,504 | 5,904,705 | 33,570,892 | 40,760,300 | 343,641 |
| 33-27 | Wyoming | 9,063,849 | 5,684,286 | 11,907,415 | 2,974,166 | 90,570 |
| 31-28 | Washington | 9,936,143 | 5,431,659 | 34,827,495 | 56,430,334 | 511,780 |
| 26-29 | Massachusetts | 16,770,561 | 4,671,855 | 42,298,274 | 657,277,001 | 2,805,346 |
| 23-30 | Wisconsin | 21,805,775 | 4,427,813 | 157,445,713 | 245,668,466 | 2,062,916 |
| 58-31 | Indian Territory..... | 6,140,446 | 4,321,380 | 27,672,002 | 3,067,274 | 392,960 |
| 40-32 | Maine | 5,227,222 | 3,656,134 | 37,113,469 | 84,210,956 | 694,466 |
| 27-33 | Nevada | 15,990,663 | 3,518,430 | 6,758,337 | 1,202,255 | 40,662 |
| 34-34 | Georgia | 8,927,361 | 3,117,358 | 104,304,476 | 78,153,576 | 2,216,331 |
| 37-35 | Florida | 6,395,825 | 2,943,806 | 18,309,104 | 27,831,890 | 528,542 |
| 41-36 | Arkansas | 4,933,899 | 2,840,341 | 6,997,097 | 19,294,742 | 122,931 |
| 39-37 | New Mexico..... | 5,805,250 | 2,686,473 | 10,155,215 | 4,122,500 | 195,310 |
| 44-38 | Oregon | 2,640,406 | 2,087,389 | 38,090,969 | 30,383,667 | 409,764 |
| 43-39 | South Carolina..... | 2,800,108 | 1,834,134 | 68,266,912 | 48,175,365 | 1,340,316 |
| 36-40 | Connecticut | 6,669,288 | 1,425,959 | 28,276,948 | 207,934,112 | 908,420 |
| 45-41 | New Hampshire..... | 2,247,927 | 1,176,312 | 21,929,988 | 77,330,702 | 411,588 |
| 42-42 | North Carolina..... | 3,062,847 | 927,376 | 89,309,638 | 74,575,155 | 1,893,810 |
| 47-43 | Rhode Island..... | 1,715,609 | 774,611 | 6,333,864 | 118,839,891 | 428,556 |
| 49-44 | Delaware | 814,126 | 448,467 | 9,290,777 | 29,378,529 | 184,735 |
| 50-45 | North Dakota..... | 731,805 | 334,967 | 64,552,494 | 7,313,081 | 312,239 |
| 30-46 | Louisiana | 10,334,030 | 279,327 | 72,667,302 | 69,785,397 | 1,381,625 |
| 29-47 | Oklahoma | 10,686,240 | 186,706 | 45,447,744 | 5,988,291 | 398,331 |
| 46-48 | Nebraska | 2,053,100 | 148,391 | 162,696,386 | 115,278,644 | 1,066,300 |
| 48-49 | Mississippi | 954,559 | | 102,492,283 | 27,813,332 | 1,551,270 |
| 51-50 | District of Columbia..... | 362,039 | | 870,247 | 25,540,496 | 278,718 |
| 19 | Alaska..... | 23,871,655 | | | | |
| | United States..... | 1,903,807,024 | 796,826,417 | 4,717,069,973 | 8,367,997,844 | 75,994,575 |

According to the United States' Geological Survey the value of the mineral products in the United States in 1906 was \$1,904,007,034, and in 1907, \$2,069,289,196, of which \$1,166,165,191 were for non-metallic products.

In 1906 the value of coal produced in Pennsylvania was \$262,208,345, nearly equally divided between the bituminous and anthracite. The coal industry is rapidly increasing, as shown by Chief James E. Roderick, who reports for the bituminous coal in 1897, 50,284,692 tons were mined, while in 1907, 149,559,047 tons were raised, or nearly three times as much as ten years previously.

Chief Roderick also reports for anthracite coal 37,644,018 tons were mined in 1887, 46,947,354 tons in 1897 and 76,836,082 tons in 1907.

According to the United States Geological Survey Pennsylvania also stood, in 1906, first of the United States in the value of its production of pig iron (\$225,970,000) or almost half of the entire output of the country, coke (\$54,184,531), Portland cement \$18,598,439), natural gas (\$18,558,245), building stone (\$8,804,776) by-products (\$7,822,548), slate (\$3,522,149), and lime (\$1,857,754). It also stands second only to Ohio in the value of its clay products (\$21,774,611) and in petroleum (\$16,596,943).

SCOPE OF INSTRUCTION IN THE SCHOOL OF MINES

The School of Mines, if it properly attends to the instruction within its province, as required by the needs of the State and Nation, must cover the work of searching for the crude mineral materials of the earth, their mode of occurrence, the methods of taking them out of the ground, and their preparation for market; and it should provide instruction in every subject required for this work.

This requires that the School give instruction in the forms of minerals, their properties and characteristics, including Crystallography, the use of the goniometer and polariscope, or Optical, Microscopical, Descriptive, and Determinative Mineralogy.

It must give instruction in the study of the rocks, including the meteorites, their general and microscopical characters, as covered by the science of Lithology and Petrology, or Petrography.

In the study of the earth it is necessary to cover the general principles of Chemical, Physical, Stratigraphical, and Field Geology, particularly in their applications to Mining and Engineering. It must further include the study of the ancient animals and plants, or Paleontology and Paleobotany, with their use, in determining the age and relations of geological formations.

On the side of Economic or Mining Geology there are to be studied all the metalliferous and non-metalliferous deposits of use to man. This work takes up their mode of occurrence and classifications; the methods of searching or prospecting for them; their uses or applications. Naturally, this division includes the geology of all ores; building and road materials; ornamental stones and gems; refractory materials; limes, mortars, and cements; ceramic materials, like clays, etc.; fluxes, materials for glass making; abrasives; fuels, like coal, coke, lignite, peat, petroleum, and natural gas; graphite, mineral paints, mineral lubricants; fertilizers; salts; pyrotechnic materials; mineral medicines and chemical materials. Owing to the great and increasing value of the clay and cement products of the country, the work of the School must give full attention to the manufacture of clays, cements, and glass, or Ceramics in its broadest sense.

The work further includes coal testing, valuation and washing, the testing and valuation of other mineral fuels, and the preparation and concentration of ores and other mineral substances for market (Ore Dressing and Coal Washing).

The work of the School includes Metallurgy in all its branches, comprising wet and fire assaying; hydro-metallurgy and electro metallurgy; the preparation and use of fuels and refractory materials; calorimetry, pyrometry, and furnaces, their construction, equipment, and use, with experimental laboratory work. Owing to its location, particular attention must be given to iron and steel metallurgy and to the manufacture of coke.

Lastly, Mining in all its numerous ramifications must be covered, including the various subjects of boring or drilling; supporting or timbering; operating or exploitation, including open cut mining or quarrying; hydraulic mining and dredging; mining law; legislation, care and education of the miner; accidents; emergencies; employment and management of labor; explosives and breaking ground; haulage or tramming; hoisting or winding; drainage or pumping; ventilation; lighting; mine air and gases; mine accounts; and the application of Mathematics and Mechanics to Mining or Mining Engineering; also the designing of mine plants; the laying out of mines; the planning of the ventilation; extinguishing of mine fires; methods of rescue; first aid in accidents; etc., etc.

The instruction, then, either in this School or in some of the other Schools in this University, must comprise all things requisite to find and obtain the earth's mineral wealth and prepare it for market. This requires that the School's students should be trained to prospect or to conduct explorations in the forest and field; to distinguish the useful minerals and rocks; to understand the geological principles that govern

the formation and association of useful mineral products, and to determine approximately their values; to study ores, building stones, limes, mortars, cement, coal, salt, gypsum, petroleum, natural gas, clays, fertilizers, gems, and other useful mineral products; to survey, map, and lay out grounds, railroads, tramways, and towns; to select or design hoisting, transportation, power, and light plants; to design mills, furnaces, docks, dams, bridges, shaft and rock houses, and other structures; to determine in each case which is the most suitable method for opening and conducting a quarry or mine, and of timbering, ventilating, and draining it; to assay, concentrate, and smelt ores; to investigate the strength and other properties of engineering materials, that designs may be intelligently worked out; to make working drawings to illustrate fully these designs; to understand the most economical methods of generating and using steam; to study in detail, engines, pumps, boilers, and other machinery, and the methods of operating, testing, and preparing them; to master the principles of electricity and its generation, storage, transmission, and use as an illuminant and a source of motive power; to study hydraulics, and its various applications in civil affairs and hydraulic mining; to understand mine management and accounts; explosives, mine gases, and the prevention of explosions and fires; to be helpful in accidents and emergencies; to understand the laws of production and supply, wages, moral and educational policies, and other economic problems; historical development; needed languages; ability to write intelligently about, and report upon his work to his employers and others; in short, to train men to be of real use in any line of work connected with the winning and preparation of mineral products for market; and to be good as well as useful citizens, looking to the interests of those under their charge, as well as to those of their employers, and those of the State and Nation. Seemingly there is no problem in life that mining men may not be confronted with.

Such work naturally arranges itself along various clearly defined lines, in each of which the training may proceed to almost any length. Hence the branches of study which most naturally resolve themselves into specialties are Drawing and Designing; Chemistry; Metallurgy; Ceramics, including cement and glass making; Mechanical, Civil, Electrical, and Mining Engineering; Mining, Ore Dressing, Coal Washing; Mineralogy, Petrography, Geology, Mining Geology, Civics, and Economics. In consequence, the men educated in mining courses are engaged quite commonly as foremen, fire bosses, mine inspectors, draughtsmen, surveyors, engineers, woodsmen, prospectors, explorers, assayers, metallurgists, ceramic engineers, mill men, mining men, mineralogists, petrographers, geologists, mining geologists, quarrymen, manufacturers, superintendents, managers, agents, teachers, etc., etc.

Men trained along these lines may be employed in the humbler work about mines, mills, and smelting works, or they may have charge of the expenditure of many millions of dollars yearly and have the oversight of thousands of human beings, as well as burdened with the care of their religious, moral, social, educational, sanitary, and political welfare.

It needs but a glance at the immense fields covered by the work properly belonging to this School to see that by no possibility can it all be crowded into any single four years' course that the mind of man can conceive. Either the work must all be of a very elementary and introductory character or it must be somewhat specialized.

The amount of work is so great that no man can do more than to obtain part of the general principles and build upon them in some one of the numerous lines of mining, metallurgical, ceramic, and geological practice.

Out of the numerous lines along which educational courses can be laid, some like the following can be specified as training men:

1. To engage in prospecting and exploring work, and to possess a thorough knowledge of the useful geological deposits, including petroleum, gas, water, etc., and their mode of occurrence—the application of Mineralogy, Petrography, and Geology to Mining—prospectors, drillers, and mining or economic geologists, or mining “experts.”

2. To cope with transportation problems, mapping, surveying, laying out of towns, railroads, erecting structures, etc.—the application of Civil Engineering to Mining and Metallurgy—surveyors, superintendents, and mining engineers.

3. To design metallurgical, hoisting and power plants, including compressors, drilling machines, etc.; to attend to ventilation and other allied problems—the application of Mechanical Engineering to Mining and Metallurgy—draughtsmen, inspectors, metallurgists, metallurgical engineers, etc.

4. To look after the electrical power, lighting, signals, haulage, electric drills, cutters, etc., in a mine—the application of Electrical Engineering to Mining and Metallurgy—mining and metallurgical engineers.

5. To do wet and fire assaying, smelting, coke preparation, electro-metallurgical work, etc.—the Metallurgical and Chemical side of Mining—metallurgical engineers, metallurgists, and assayers.

6. To understand the problems involved in Stamp Mills and other concentrating plants—the Ore Dressing and Coal Washing side of Mining—mill men, superintendents, etc.

7. The management of mining or mineral properties or estates, including the mining laws; to have a gentleman's or business man's or a lawyer's education on one hand and a mining or metallurgical one on the

other—the application of the principles of business and law to Mining and Metallurgy—managers and agents.

8. To be prepared to handle the problems relating to building stones, including slates, clays, limes, mortars, cements, glass, etc.—the application of Geological and Mining principles to Ceramics, the preparation of cements, concretes, and other building materials—foremen, quarrymen, prospectors, superintendents, managers, etc.

9. To become general utility men about the smaller mines and mineral properties, who must be able to do in a limited way almost any kind of work above mentioned—mining-men, fire bosses, foremen, inspectors, superintendents, etc.

10. To serve as teachers or educators for students in Mining, Metallurgy, Ceramics, Geology, Mineralogy, etc.—instructors and professors.

11. To train men for work in various lines upon the geological surveys of the country—geologists and explorers.

Men to do the above work well about mines and other mineral properties must receive a special training in and knowledge of the minerals and rocks, as well as in the geological structure of the earth, and the general methods of mining. It thus becomes necessary, or at least advantageous, for the student to take the needed geological and mining studies, and to finish out his course with the special subjects he expects to use.

To repeat, it can be said that at this day it is impossible to train all men in a single course in mining, unless all are to be turned out as general utility or mediocre men, or all warped in a fixed direction, and suitable for one or two lines of mining or metallurgy only. It is not the men who know a little of everything who lead. It is rather those who realize that they know some one thing well and have the mental strength that comes from such knowledge and its attendant discipline.

The range of subjects bearing on the mineral industry is extremely wide. This, coupled with the fact that all men are endowed with a natural aptitude for some lines of work, while wholly unfitted for others, and the further fact that circumstances beyond control force some men into particular occupations, demonstrates that the student must have some liberty in selecting the studies which are to enable him to cope with his life work. This is recognized here, and met by selecting certain studies that are considered essential for any man to have who is to devote himself to subjects germane to the purposes of this School, with additional subjects from which the student is to select enough to complete his course.

Out of the numerous schemes for courses that could be adopted to reach the end sought—to give the best, highest, and most practical education, in accordance with the demands of the times—it is thought

that the plan used here is amongst the simplest that will satisfy the varied demands of the mining, metallurgical, ceramic, and geological industries, in a School of Mines that is connected with a university and is to be conducted upon a university plan. It is a combination of required or essential group, and elective or optional studies.

OUTLINE OF STUDIES AVAILABLE FOR DEGREES

The Outline given below covers both the required and optional or elective studies, the required studies and the conditions under which a degree can be obtained is given in the later part of the Bulletin.

In the list below in the left-hand column is the number or abbreviation by which each subject is designated. The right-hand column indicates the number of credits allowed for each subject.

The student is referred to the complete title and requirements for each subject given beyond for the subjects that are taught in the School of Mines. For a description of the subjects taught in the other schools and colleges of the University the student is referred to the University catalog which will be sent upon application to the Secretary of the University. In selecting his subjects he must be governed by the requirements in each case and by the general rules.

Students in the School of Mines are allowed to elect studies in the College, Engineering School, or in any other of the schools of the University, if they are properly prepared, by arranging with the Dean of that school, the instructor in the subject selected, and the Dean of the School of Mines.

To aid the student in the selection of his elective or optional studies some tentative or advisory courses have been arranged to serve as illustrations. These are given in the later part of this Bulletin.

FRESHMAN YEAR—FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|----------|--------------------------------------|---------|
| Min. 1 | Crystallography and Mineralogy | 6 |
| Min. 9 | Crystallography and Mineralogy | 1 to 12 |
| Min. 35 | Blowpipe Analysis | 1 or 2 |
| Pal. 1 | Paleontology | 2 |
| Pal. 9 | Paleobotany | 2 |
| Pal. 17 | Paleontological Laboratory | 1 to 12 |
| Pal. 27 | Paleobotanical Laboratory | 1 to 12 |
| Geol. 1 | Principles of Physical Geography | 2 |
| Geol. 5 | General Geology | 2 |
| Geol. 7 | Biological Geology | 2 |
| Geol. 47 | Geological Laboratory and Field Work | 2 |
| Geol. 55 | Geological Laboratory and Field Work | 1 to 12 |

| NUMBER | SUBJECT | CREDITS |
|------------|----------------------------------|---------|
| 169 | Plane and Spherical Trigonometry | 3 |
| M. Geol. 1 | The Principles of Mining Geology | 2 |
| 1 | History of the Hebrews | 1 |
| 50 | Mediæval History | 3 |
| 69a | Principles of Accounting | 3 |
| 75 | Beginner's Course in Greek | 4 |
| 76 | Herodotus | 4 |
| 95 | Livy | 3 |
| 115 | French, First Year Course | 3 |
| 130 | German, First Year Course | 3 |
| 145 | Rhetoric and Composition | 3 |
| 146 | Advanced Rhetoric | 2 |
| 165 | Algebra | 3 |
| 166 | Advanced Algebra | 3 |
| 185 | General Experimental Chemistry | 5 |
| 194 | Chemical Calculations | 1 |
| 370 | Mechanical Drawing | 2 |
| 380 | Framing and Pattern Making | 1 |
| 390 | Gymnasium | 1 |

FRESHMAN YEAR—SECOND SEMESTER.

| | | |
|------------|--------------------------------------|---------|
| Min. 2 | Mineralogy and Petrography | 6 |
| Min. 10 | Mineralogy and Petrography | 1 to 12 |
| Min. 36 | Blowpipe Analysis | 1 or 2 |
| Pal. 2 | Paleontology | 2 |
| Pal. 10 | Paleobotany | 2 |
| Pal. 18 | Paleontological Laboratory | 1 to 12 |
| Pal. 28 | Paleobotanical Laboratory | 1 to 12 |
| Geol. 2 | Physical Geography (Meteorology) | 2 |
| Geol. 6 | Structural and Field Geology | 2 |
| Geol. 8 | Stratigraphical Geology | 2 |
| Geol. 48 | Geological Laboratory and Field Work | 1 to 12 |
| Geol. 56 | Geological Laboratory and Field Work | 1 to 12 |
| M. Geol. 2 | The Principles of Mining Geology | 2 |
| 1 | History of the Hebrews | 1 |
| 51 | Modern History | 3 |
| 69a | Principles of Accounting | 3 |
| 75 | Beginner's Course in Greek | 4 |
| 77 | Homer, Odyssey | 3 |
| 96 | Cicero | 3 |
| 116 | French, First Year Course | 3 |
| 131 | German, First Year Course | 3 |

OUTLINE OF STUDIES

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| NUMBER | SUBJECT | CREDITS |
|----------|---------------------------------|---------|
| 145 | Rhetoric and Composition | 3 |
| 146 | Advanced Rhetoric | 2 |
| 148a | Public Speaking | 1 |
| 167, 168 | Plane and Solid Geometry | 3 |
| 172 | Surveying | 3 |
| 174 | Analytic Geometry | 4 |
| 186 | Qualitative Analysis | 3 |
| 194 | Chemical Calculations | 1 |
| 229 | General Biology | 2 |
| 235 | Personal Hygiene | 2 |
| 371 | Mechanical Drawing | 2 |
| 381 | Foundry Work and Pattern Design | 2 |
| 391 | Gymnasium | 1 or 2 |

FRESHMAN YEAR—SUMMER VACATION.

FOUR TO TWELVE WEEKS.

| | | |
|-------------|----------------------------------|---------|
| Min. 27 | Practical Work in Mineralogy | 6 to 18 |
| M.Sur. 7 | Practical Work in Surveying | 6 to 18 |
| Met. 88 | Practical Work in Metallurgy | 6 to 18 |
| Pal. 37 | Practical Work in Paleontology | 6 to 18 |
| Geol. 65 | Practical Work in Geology | 6 to 18 |
| M. Geol. 46 | Practical Work in Mining Geology | 6 to 18 |
| Mine. 53 | Practical Work in Mining | 6 to 18 |

SOPHOMORE YEAR—FIRST SEMESTER.

| | | |
|-----------|--------------------------------------|---------|
| Min. 3 | Mineralogy and Petrography | 2 |
| Min. 7 | Mineralogy and Petrography | 1 to 12 |
| Min. 17 | Mathematical Crystallography | 2 to 12 |
| Pet. 1 | Microscopical Mineralogy | 2 |
| Pet. 9 | Petrographical Laboratory | 2 |
| Pet. 15 | Petrographical Laboratory | 1 to 12 |
| M. Sur. 1 | Mine Surveying | 2 |
| Met. 1 | Principles of Metallurgy | 2 |
| Met. 2 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 4 | Furnaces, Refractory Materials, etc. | 2 |
| Met. 7 | Metallurgical Calculations | 2 |
| Met. 13 | Metallography | 2 |
| Met. 40 | Metallurgical Laboratory | 2 |
| Met. 46 | Metallurgical Laboratory | 1 to 12 |
| Met. 68 | Fire Assaying | 2 |
| Met. 74 | Wet Assaying | 2 |

| NUMBER | SUBJECT | CREDITS |
|-------------|--|---------|
| Met. 82 | Assaying Laboratory | 1 to 12 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| Ore. 12 | Ore Dressing Laboratory | 2 |
| Ore. 18 | Ore Dressing Laboratory | 1 to 12 |
| Ore. 24 | Coal Washing Laboratory | 2 |
| Ore. 30 | Coal Washing Laboratory | 1 to 12 |
| Pal. 3 | Paleontology | 2 |
| Pal. 11 | Paleobotany | 2 |
| Pal. 19 | Paleontological Laboratory | 1 to 12 |
| Pal. 29 | Paleobotanical Laboratory | 1 to 12 |
| Geol. 3 | Physical Geography | 2 |
| Geol. 9 | Physical and Chemical Geology | 2 |
| Geol. 14 | Paleozoic Geology | 2 |
| Geol. 49 | Geological Laboratory and Field Work | 2 |
| Geol. 57 | Geological Laboratory and Field Work | 1 to 12 |
| M. Geol. 3 | Metallites or Non-Metalliferous Deposits | 2 |
| M. Geol. 5 | Metallites or Metalliferous Deposits | 2 |
| M. Geol. 9 | Clays—Their Origin, Occurrence, etc. | 2 |
| M. Geol. 11 | Lime, Plaster, and Cement Materials | 2 |
| M. Geol. 38 | Mining Geological Laboratory | 2 to 12 |
| Cer. 1 | Clay Testing | 2 |
| Cer. 3 | Bricks, Tiles, Terra Cotta, etc. | 2 |
| Cer. 5 | Limes, Plasters, and Cements | 2 |
| Cer. 21 | Ceramic Laboratory | 2 |
| Cer. 27 | Ceramic Laboratory | 1 to 12 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| Mine. 44 | Mining Laboratory and Design | 2 |
| Mine. 50 | Mining Laboratory and Design | 1 to 12 |
| 2 | The Life of Christ | 2 |
| 25 | General Psychology | 3 |
| 52 | History of England | 3 |
| 60 | Political Economy | 3 |
| 61 | Economics | 2 |
| 78 | Lysias and Demosthenes | 2 |
| 97 | Horace | 3 |
| 117 | French, Second Year Course | 3 |
| 119 | French, Third Year Course | 3 |
| 132 | German, Second Year Course | 3 |
| 134 | German, Advanced Course | 3 |
| 146 | Development of English Prose | 3 |
| 148 | Public Speaking | 1 |
| 150 | English Literature | 2 |
| 173 | Surveying and Topography | 3 |

OUTLINE OF STUDIES

19

| NUMBER | SUBJECT | CREDITS |
|--------|-------------------------------|---------|
| 175 | Calculus | 3 |
| 187 | Quantitative Analysis | 3 |
| 192 | Organic Chemistry | 4 |
| 210 | General Physics | 4 |
| 211 | Practical Physics | 4 |
| 225 | General Biology, Minor Course | 2 |
| 228 | Bacteriology | 3 |
| 290c | Surveying | 3 |
| 373 | Descriptive Geometry | 3 |
| 382 | Forging, Welding, etc. | 2 |
| 391 | Gymnasium | 1 |

SOPHOMORE YEAR—SECOND SEMESTER.

| | | |
|----------|--------------------------------------|---------|
| Min. 4 | Mineralogy and Petrography | 2 |
| Min. 12 | Mineralogy and Petrography | 1 to 12 |
| Min. 18 | Mathematical Crystallography | 2 to 12 |
| Pet. 2 | Microscopical Mineralogy | 2 |
| Pet. 10 | Petrographical Laboratory | 2 |
| Pet. 16 | Petrographical Laboratory | 1 to 12 |
| M.Sur. 2 | Mine Surveying | 2 |
| Met. 3 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 5 | Furnaces, Refractory Materials, etc. | 2 |
| Met. 6 | Alloys, etc. | 2 |
| Met. 8 | Metallurgical Calculations | 2 |
| Met. 14 | Metallography | 2 |
| Met. 41 | Metallurgical Laboratory | 2 |
| Met. 47 | Metallurgical Laboratory | 1 to 12 |
| Met. 69 | Fire Assaying | 2 |
| Met. 75 | Wet Assaying | 2 |
| Met. 83 | Assaying Laboratory | 1 to 12 |
| Ore. 2 | Ore Dressing Operations, etc. | 2 |
| Ore. 7 | Coal Washing, etc. | 2 |
| Ore. 13 | Ore Dressing Laboratory | 2 |
| Ore. 19 | Ore Dressing Laboratory | 1 to 12 |
| Ore. 25 | Coal Washing Laboratory | 2 |
| Ore. 31 | Coal Washing Laboratory | 1 to 12 |
| Pal. 4 | Paleontology | 2 |
| Pal. 12 | Paleobotany | 2 |
| Pal. 20 | Paleontological Laboratory | 1 to 12 |
| Pal. 30 | Paleobotanical Laboratory | 1 to 12 |
| Geol. 4 | Physical Geography | 2 |
| Geol. 10 | Physical and Chemical Geology | 2 |

| NUMBER | SUBJECT | CREDITS |
|-------------|--------------------------------------|---------|
| Geol. 14 | Paleozoic Geology | 2 |
| Geol. 50 | Geological Laboratory and Field Work | 2 |
| Geol. 58 | Geological Laboratory and Field Work | 1 to 12 |
| M. Geol. 4 | Building and Ornamental Stones | 2 |
| M. Geol. 6 | Metallites or Metalliferous Deposits | 2 |
| M. Geol. 10 | Clays—Their Origin, Occurrence, etc. | 2 |
| M. Geol. 12 | Lime, Plaster, and Cement Materials | 2 |
| M. Geol. 13 | Materials for Glazes, Enamels, etc. | 2 |
| M. Geol. 39 | Mining Geological Laboratory | 2 to 12 |
| Cer. 2 | Clay Mining and Manufacture | 2 |
| Cer. 4 | Bricks, Tiles, Terra Cotta, etc. | 2 |
| Cer. 6 | Limes, Plasters, and Cements | 2 |
| Cer. 21 | Ceramic Laboratory | 2 |
| Cer. 27 | Ceramic Laboratory | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| Mine. 45 | Mining Laboratory and Design | 2 |
| Mine. 51 | Mining Laboratory and Design | 1 to 12 |
| 3 | History of Apostolic Age | 1 |
| 7b | Ethics | 2 |
| 25 | General Psychology | 3 |
| 52 | History of England | 3 |
| 60 | Political Economy | 3 |
| 79 | Euripides | 3 |
| 98 | Tacitus and Horace | 3 |
| 118 | French | 3 |
| 120 | French, Third Year Course | 3 |
| 133 | German, Second Year Course | 3 |
| 134 | German, Advanced Course | 3 |
| 147 | History of the English Language | 3 |
| 148 | Public Speaking | 1 |
| 151 | American Literature | 2 |
| 175 | Calculus | 3 |
| 176 | Analytic Mechanics | 4 |
| 187 | Quantitative Analysis | 3 |
| 192 | Organic Chemistry | 4 |
| 196b | Micro-Chemical Analysis | 2 |
| 210 | General Physics | 4 |
| 211 | Practical Physics | 4 |
| 225 | General Biology, Minor Course | 4 |
| 228 | Bacteriology | 3 |
| 372 | Machine Sketching and Drawing | 2 |
| 383 | Machine Work in Metal | 2 |

OUTLINE OF STUDIES

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SOPHOMORE YEAR—SUMMER VACATION.

FOUR TO TWELVE WEEKS.

| | | |
|-------------|--|---------|
| Min. 28 | Practical Work in Mineralogy | 6 to 18 |
| Pet. 23 | Practical Work in Petrography | 6 to 18 |
| M. Sur. 8 | Practical Work in Surveying | 6 to 18 |
| Met. 89 | Practical Work in Metallurgy | 6 to 18 |
| Met. 93 | Practical Work in Assaying | 6 to 18 |
| Ore. 40 | Practical Work in Ore Dressing | 6 to 18 |
| Ore. 44 | Practical Work in Coal Washing, etc. | 6 to 18 |
| Pal. 38 | Practical Work in Paleontology | 6 to 18 |
| Pal. 43 | Practical Work in Paleobotany | 6 to 18 |
| Geol. 66 | Practical Work in Geology | 6 to 18 |
| M. Geol. 47 | Practical Work in Mining Geology | 6 to 18 |
| Cer. 45 | Practical Work in Ceramics | 6 to 18 |
| Cer. 49 | Practical Work in Brick, Tile, Terra Cotta, etc. | 6 to 18 |
| Cer. 57 | Practical Work in Cement Manufacture | 6 to 18 |
| Mine. 59 | Practical Work in Mining | 6 to 18 |

JUNIOR YEAR—FIRST SEMESTER.

| | | |
|-----------|--|---------|
| M. Sur. 3 | Mine Surveying | 2 |
| Min. 5 | Mineralogy and Petrography | 2 |
| Min. 13 | Mineralogy and Petrography | 1 to 12 |
| Min. 19 | Physical Mineralogy | 2 to 12 |
| Min. 38 | Chemical Mineralogy | 2 |
| Pet. 3 | Microscopical Petrography | 2 |
| Pet. 11 | Petrographical Laboratory | 2 |
| Pet. 17 | Petrographical Laboratory | 1 to 12 |
| Met. 9 | Metallurgical Calculations | 2 |
| Met. 15 | Metallurgy of Iron, Foundry Work, etc. | 2 |
| Met. 19 | Metallurgy of Gold and Silver | 2 |
| Met. 28 | Hydro-Metallurgy | 2 |
| Met. 32 | Electro-Metallurgical Processes | 2 |
| Met. 36 | Metallurgical Designing | 1 to 12 |
| Met. 42 | Metallurgical Laboratory | 2 |
| Met. 48 | Metallurgical Laboratory | 1 to 12 |
| Met. 52 | Hydro-Metallurgical Laboratory | 2 |
| Met. 56 | Hydro-Metallurgical Laboratory | 1 to 12 |
| Met. 60 | Electro-Metallurgical Laboratory | 2 |
| Met. 64 | Electro-Metallurgical Laboratory | 1 to 12 |
| Met. 70 | Fire Assaying | 2 |
| Met. 76 | Wet Assaying | 2 |
| Met. 84 | Assaying Laboratory | 1 to 12 |

| NUMBER | SUBJECT | CREDITS |
|-------------|--|---------|
| Met. 115 | Coke—Its Manufacture, Properties, and Uses | 2 |
| Ore. 3 | Ore Dressing Operations | 2 |
| Ore. 8 | Coal Washing, etc. | 2 |
| Ore. 14 | Ore Dressing Laboratory | 2 |
| Ore. 20 | Ore Dressing Laboratory | 1 to 12 |
| Ore. 26 | Coal Washing Laboratory | 2 |
| Ore. 32 | Coal Washing Laboratory | 1 to 12 |
| Pal. 5 | Paleontology | 2 |
| Pal. 13 | Paleobotany | 2 |
| Pal. 21 | Paleontological Laboratory | 1 to 12 |
| Pal. 31 | Paleobotanical Laboratory | 1 to 12 |
| Geol. 15 | Mesozoic and Cenozoic Geology | 2 |
| Geol. 17 | Glacial Geology | 2 |
| Geol. 51 | Geological Laboratory and Field Work | 2 |
| Geol. 59 | Geological Laboratory and Field Work | 1 to 12 |
| M. Geol. 7 | Ore Deposits of the United States | 2 |
| M. Geol. 16 | Coal—Its Origin, Occurrence, etc. | 2 |
| M. Geol. 22 | Iron and Manganese Ores | 2 |
| M. Geol. 40 | Mining Geological Laboratory | 2 to 12 |
| Cer. 7 | Glazes, Enamels, and Colors | 2 |
| Cer. 9 | Manufacture of Glass, etc. | 2 |
| Cer. 11 | Ceramic Calculations | 2 |
| Cer. 13 | Cements—Their Manufacture, etc. | 2 |
| Cer. 17 | Fire Brick—Manufacture, Properties, etc. | 2 |
| Cer. 23 | Ceramic Laboratory | 2 |
| Cer. 29 | Ceramic Laboratory | 1 to 12 |
| Cer. 35 | Laboratory Work in Glass Making | 2 |
| Cer. 39 | Laboratory Work in Glass Making | 1 to 12 |
| Mine. 3 | Mine Calculations and Estimates | 2 |
| Mine. 5 | Coal Mining | 2 |
| Mine. 7 | Metal Mining | 2 |
| Mine. 9 | Mining Engineering | 2 |
| Mine. 13 | Mine Gases, Ventilation, Lighting, etc. | 2 |
| Mine. 17 | Mine Management, Accounts, Supplies, etc. | 2 |
| Mine. 19 | Mining and Ventilating Machinery | 2 |
| Mine. 21 | Power Generation and Transmission | 2 |
| Mine. 38 | Hydraulic Mining and Dredging | 2 |
| Mine. 46 | Mining Laboratory and Design | 2 |
| Mine. 52 | Mining Laboratory and Design | 1 to 12 |
| Mine. 65 | Electricity Applied to Mining | 2 |
| Law 1 | Principles of Law and Mining Law | 2 |
| 4 | Theism | 2 |
| 7 | Ethics | 3 |

OUTLINE OF STUDIES

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| NUMBER | SUBJECT | CREDITS |
|--------|---|---------|
| 10 | History of Philosophy | 3 |
| 27 | Comparative and Genetic Psychology | 2 |
| 42 | History of Education | 2 |
| 53 | History of France | 2 |
| 57 | United States Citizenship | 2 |
| 59a | American Diplomacy | 2 |
| 63 | Transportation | 2 |
| 64 | Modern Industries and Industrial Management | 2 |
| 69b | Practical Accounting | 3 |
| 80 | Plato | 3 |
| 85 | New Testament Greek | 1 |
| 86 | Principles of the Fine Arts | 2 |
| 88 | Classical Literature in English | 3 |
| 99 | Roman Law | 3 |
| 101 | The Roman Drama | 3 |
| 119 | French, Third Year Course | 3 |
| 121 | French, Philosophy | 3 |
| 135 | German, Third Year Course | 3 |
| 137 | Advanced German Literature | 3 |
| 149 | Advanced Public Speaking and Writing | 1 |
| 152 | The Drama and Shakespeare | 3 |
| 154a | The Classical Period | 2 |
| 188 | Quantitative Analysis | 3 |
| 193 | Advanced Organic Chemistry | 3 |
| 199 | Theoretical Chemistry | 2 |
| 201 | Chemical German | 2 |
| 204 | Water Supply and Purification | 1 |
| 212 | Advanced Optics | 3 |
| 226 | Botany | 3 |
| 227 | Zoology | 3 |
| 228 | Bacteriology | 3 |
| 251 | Historical Geology and Paleontology | 3 |
| 285 | Mechanics of Materials | 2 |
| 287 | Graphic Statics | 2 |
| 290d | Higher Surveying | 4 |
| 305 | Machine Design and Drawing | 3 |
| 308 | Kinematics | 2 |
| 317 | Mechanical Laboratory | 1 |
| 330 | Elements of Electrical Engineering | 4 |
| 331 | Electrical Laboratory | 2 |
| 332 | Direct Current Theory | 3 |
| 333 | Telegraphy and Telephony | 1 |
| 339 | Electro-Chemistry | 2 |

| NUMBER | SUBJECT | CREDITS |
|--------|-----------------------|---------|
| 373a | Stereotomy | 2 |
| 383 | Machine Work in Metal | 1 |

JUNIOR YEAR—SECOND SEMESTER.

| | | |
|-----------|---|---------|
| M. Sur. 4 | Mine Surveying | 2 |
| Min. 6 | Mineralogy and Petrography | 2 |
| Min. 14 | Mineralogy and Petrography | 1 to 12 |
| Min. 20 | Physical Mineralogy | 2 to 12 |
| Min. 39 | Chemical Mineralogy | 2 |
| Pet. 4 | Microscopical Petrography | 2 |
| Pet. 12 | Petrographical Laboratory | 2 |
| Pet. 18 | Petrographical Laboratory | 1 to 12 |
| Met. 10 | Metallurgical Calculations | 2 |
| Met. 16 | Metallurgy of Iron, etc. | 2 |
| Met. 20 | Metallurgy of Gold and Silver | 2 |
| Met. 29 | Hydro-Metallurgy | 2 |
| Met. 33 | Electro-Metallurgical Processes | 2 |
| Met. 37 | Metallurgical Designing | 1 to 12 |
| Met. 43 | Metallurgical Laboratory | 2 |
| Met. 49 | Metallurgical Laboratory | 1 to 12 |
| Met. 53 | Hydro-Metallurgical Laboratory | 2 |
| Met. 57 | Hydro-Metallurgical Laboratory | 1 to 12 |
| Met. 61 | Electro-Metallurgical Laboratory | 2 |
| Met. 65 | Electro-Metallurgical Laboratory | 1 to 12 |
| Met. 71 | Fire Assaying | 2 |
| Met. 77 | Wet Assaying | 2 |
| Met. 85 | Assaying Laboratory | 1 to 12 |
| Met. 116 | Coke—Its Manufacture, Properties and Uses | 2 |
| Ore. 4 | Ore Dressing Operations | 2 |
| Ore. 9 | Coal Washing, etc. | 2 |
| Ore. 15 | Ore Dressing Laboratory | 2 |
| Ore. 21 | Ore Dressing Laboratory | 1 to 12 |
| Ore. 27 | Coal Washing Laboratory | 2 |
| Ore. 33 | Coal Washing Laboratory | 1 to 12 |
| Pal. 6 | Paleontology | 2 |
| Pal. 14 | Paleobotany | 2 |
| Pal. 32 | Paleontological Laboratory | 1 to 12 |
| Pal. 20 | Paleobotanical Laboratory | 1 to 12 |
| Geol. 16 | Mesozoic and Cenozoic Geology | 2 |
| Geol. 18 | Glacial Geology | 2 |
| Geol. 52 | Geological Laboratory and Field Work | 2 |
| Geol. 60 | Geological Laboratory and Field Work | 1 to 12 |

OUTLINE OF STUDIES

25

| NUMBER | SUBJECT | CREDITS |
|-------------|---|---------|
| M. Geol. 8 | Ore Deposits of the United States | 2 |
| M. Geol. 17 | Coal—Its Origin, etc. | 2 |
| M. Geol. 23 | Iron and Manganese Ores | 2 |
| M. Geol. 41 | Mining Geological Laboratory | 2 to 12 |
| Cer. 8 | Glazes, Enamels, and Colors | 2 |
| Cer. 10 | Manufacture of Glass | 2 |
| Cer. 12 | Ceramic Construction | 2 |
| Cer. 14 | Cements—Their Manufacture, etc. | 2 |
| Cer. 18 | Manufacture of Sand-Lime-Brick, etc. | 2 |
| Cer. 20 | Ceramic Laboratory | 2 |
| Cer. 34 | Ceramic Laboratory | 1 to 12 |
| Cer. 36 | Laboratory Work in Glass Making | 2 |
| Cer. 40 | Laboratory Work in Glass Making | 1 to 12 |
| Mine. 4 | Mine Calculations and Estimates | 2 |
| Mine. 6 | Coal Mining | 2 |
| Mine. 8 | Metal Mining | 2 |
| Mine. 10 | Mining Engineering | 2 |
| Mine. 14 | Mine Gases, Ventilation, etc. | 2 |
| Mine. 18 | Mine Management, Accounts, Supplies, etc. | 2 |
| Mine. 20 | Mining and Ventilating Machinery | 2 |
| Mine. 22 | Power Generation and Transmission | 2 |
| Mine. 39 | Hydraulic Mining and Dredging | 2 |
| Mine. 47 | Mining Laboratory and Design | 2 |
| Mine. 53 | Mining Laboratory and Design | 1 to 12 |
| Mine. 66 | Electricity Applied to Mining | 2 |
| Law 2 | Mining Law and Mining Injuries | 2 |
| 5 | Comparative Religion | 2 |
| 8 | History of Ethics | 3 |
| 11 | History of Modern Philosophy, etc. | 3 |
| 12 | Logic | 3 |
| 26 | Experimental Psychology | 2 |
| 28 | Abnormal and Individual Psychology | 2 |
| 32 | General Psychology | 2 |
| 33 | General Psychology for Technical Students | 2 |
| 41 | Educational Psychology | 2 |
| 53 | History of France | 2 |
| 58 | Municipal Government | 2 |
| 59b | International Law | 2 |
| 65 | Corporation Finance | 2 |
| 66 | Investments | 2 |
| 69b | Practical Accounting | 3 |
| 72 | Problems of Sociology | 2 |
| 81 | Sophocles and Aeschylus | 3 |

SCHOOL OF MINES

| NUMBER | SUBJECT | CREDITS |
|--------|---------------------------------------|---------|
| 85 | New Testament Greek | 1 |
| 87 | Greek Art | 2 |
| 88 | Classical Literature in English | 3 |
| 100 | Roman Law | 3 |
| 102 | Roman Rhetoric and Oratory | 3 |
| 120 | French, Third Year Course | 3 |
| 122 | French Philosophy | 3 |
| 136 | German, Third Year Course | 3 |
| 137 | Advanced German Literature | 3 |
| 149 | Advanced Public Speaking and Writing | 1 |
| 153 | The English Novel | 3 |
| 154b | Revival of Romanticism | 2 |
| 188 | Quantitative Analysis | 3 |
| 190 | Gas Analysis | 2 |
| 191 | Electro-Chemical Analysis | 2 |
| 193 | Advanced Organic Chemistry | 3 |
| 198 | Water Examination | 3 |
| 204 | Water Supply and Purification | 1 |
| 213 | Electricity and Magnetism | 3 |
| 226 | Botany | 3 |
| 227 | Zoology | 3 |
| 228 | Bacteriology | 3 |
| 260 | General Astronomy | 2 |
| 286 | Hydro-Mechanics and Hydraulics | 3 |
| 288 | Stresses in Trusses and Bridge Design | 4 |
| 289 | Masonry Construction and Foundations | 2 |
| 290 | Structural Engineering | 4 |
| 290 | Structural Engineering | 4 |
| 305 | Machine Design and Drawing | 3 |
| 307 | Thermodynamics | 3 |
| 318 | Hydraulic Laboratory | 1 |
| 330 | Elements of Electrical Engineering | 4 |
| 331 | Electrical Laboratory | 1 or 2 |
| 335 | Alternating Current Theory | 3 |

JUNIOR YEAR—SUMMER VACATION.

FOUR TO TWELVE WEEKS.

| | | |
|-----------|-------------------------------|---------|
| M. Sur. 9 | Practical Work in Surveying | 6 to 18 |
| Min. 29 | Practical Work in Mineralogy | 6 to 18 |
| Pet. 24 | Practical Work in Petrography | 6 to 18 |
| Met. 90 | Practical Work in Metallurgy | 6 to 18 |
| Met. 94 | Practical Work in Assaying | 6 to 18 |

OUTLINE OF STUDIES

27

| NUMBER | SUBJECT | CREDITS |
|-------------|--|---------|
| Met. 97 | Practical Work in Hydro-Metallurgy | 6 to 18 |
| Met. 100 | Practical Work in Electro-Metallurgy | 6 to 18 |
| Ore. 42 | Practical Work in Ore Dressing | 6 to 18 |
| Ore. 46 | Practical Work in Coal Washing | 6 to 18 |
| Pal. 39 | Practical Work in Paleontology | 6 to 18 |
| Pal. 44 | Practical Work in Paleobotany | 6 to 18 |
| Geol. 67 | Practical Work in Geology | 6 to 18 |
| M. Geol. 48 | Practical Work in Mining Geology | 6 to 18 |
| Cer. 46 | Practical Work in Ceramics | 6 to 18 |
| Cer. 50 | Practical Work in Brick, Tile, Terra Cotta, etc. | 6 to 18 |
| Cer. 53 | Practical Work in Limes, Plasters, and Cements | 6 to 18 |
| Cer. 58 | Practical Work in Cement Manufacture | 6 to 18 |
| Cer. 61 | Practical Work in Concrete Construction | 6 to 18 |
| Cer. 64 | Practical Work in Glass Making | 6 to 18 |
| Mine. 60 | Practical Work in Mining | 6 to 18 |

SENIOR YEAR—FIRST SEMESTER.

| | | |
|-----------|---|---------|
| M. Sur. 5 | Mine Surveying | 2 |
| Min. 7 | Mineralogy and Petrography | 2 |
| Min. 15 | Mineralogy and Petrography | 1 to 12 |
| Min. 21 | Physical Mineralogy | 2 to 12 |
| Min. 40 | Chemical Mineralogy | 2 to 12 |
| Pet. 5 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 13 | Petrographical Laboratory | 2 |
| Pet. 19 | Petrographical Laboratory | 1 to 12 |
| Met. 11 | Metallurgical Calculations | 2 |
| Met. 17 | The Metallurgy of Steel | 3 |
| Met. 21 | The Metallurgy of Copper | 2 |
| Met. 23 | The Metallurgy of Lead | 2 |
| Met. 25 | The Metallurgy of Zinc | 2 |
| Met. 26 | The Metallurgy of the Minor Metals | 2 |
| Met. 30 | Hydro-Metallurgy | 2 |
| Met. 34 | Electro-Metallurgy | 2 |
| Met. 38 | Metallurgical Designing | 1 to 12 |
| Met. 44 | Metallurgical Laboratory | 2 |
| Met. 50 | Metallurgical Laboratory | 1 to 12 |
| Met. 54 | Hydro-Metallurgical Laboratory | 2 |
| Met. 58 | Hydro-Metallurgical Laboratory | 1 to 12 |
| Met. 52 | Electro-Metallurgical Laboratory | 2 |
| Met. 66 | Electro-Metallurgical Laboratory | 1 to 12 |
| Met. 72 | Fire Assaying | 2 |
| Met. 78 | Wet Assaying | 2 |
| Met. 86 | Assaying Laboratory | 1 to 12 |

| NUMBER | SUBJECT | CREDITS |
|-------------|--|---------|
| Ore. 5 | Gold and Silver Milling | 2 |
| Ore. 10 | Coal Washing, etc. | 2 |
| Ore. 16 | Ore Dressing Laboratory | 2 |
| Ore. 22 | Ore Dressing Laboratory | 1 to 12 |
| Ore. 28 | Coal Washing Laboratory | 2 |
| Ore. 34 | Coal Washing Laboratory | 1 to 12 |
| Pal. 7 | Paleontology | 2 |
| Pal. 15 | Paleobotany | 2 |
| Pal. 23 | Paleontological Laboratory | 1 to 12 |
| Pal. 33 | Paleobotanical Laboratory | 1 to 12 |
| Geol. 11 | Azoic or Archæan Geology | 2 |
| Geol. 19 | Prehistoric Man | 2 |
| Geol. 21 | Geology of the United States | 2 |
| Geol. 53 | Geological Laboratory and Field Work | 2 |
| Geol. 61 | Geological Laboratory and Field Work | 1 to 12 |
| M. Geol. 14 | Precious Stones or Gems | 2 |
| M. Geol. 18 | Petroleum, Natural Gas, etc. | 2 |
| M. Geol. 26 | Copper Deposits | 2 |
| M. Geol. 28 | Gold, Silver, and Silver Lead Deposits | 2 |
| M. Geol. 36 | Genesis of Ore Deposits | 2 |
| M. Geol. 42 | Mining Geological Laboratory | 2 to 12 |
| Cer. 15 | Concrete—Its Properties, etc | 2 |
| Cer. 19 | Manufacture of Pottery and Porcelain | 2 |
| Cer. 25 | Ceramic Laboratory | 2 |
| Cer. 31 | Ceramic Laboratory | 1 to 12 |
| Cer. 37 | Laboratory Work in Glass Making | 2 |
| Cer. 41 | Laboratory Work in Glass Making | 1 to 12 |
| Mine. 11 | Mining Engineering | 2 |
| Mine. 15 | "Laying Out" of Mines and Mine Plants | 2 |
| Mine. 23 | Mine Drainage and Pumping | 2 |
| Mine. 25 | Drilling, Boring, Excavating, etc. | 2 |
| Mine. 27 | Supporting or Timbering | 2 |
| Mine. 29 | Mine Prospecting, Sampling, Valuation, etc. | 2 |
| Mine. 31 | Mine Explosives—Care and Use | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, Care, etc. | 2 |
| Mine. 35 | Mining for Petroleum, Natural Gas, Asphaltum, and other Hydro-Carbons | 2 |
| Mine. 37 | Mine Timber | 2 |
| Mine. 48 | Mining Laboratory and and Design | 2 |
| Mine. 54 | Mining Laboratory and Design | 1 to 12 |
| Mine. 67 | Electricity Applied to Mining | 2 |
| Law 3 | Advanced Mining Law | 2 |

OUTLINE OF STUDIES

29

| NUMBER | SUBJECT | CREDITS |
|--------|---|---------|
| Law 5 | Law Relating to Oil and Gas | 2 |
| 29 | Systematic Psychology | 2 |
| 30 | Social Psychology | 2 |
| 40 | General Pedagogy | 2 |
| 42 | History of Education | 2 |
| 54 | The Political and Constitutional History of U. S. | 2 |
| 55a | Constitutional History of England | 3 |
| 55b | History of the 19th Century in Europe | 2 |
| 67 | Tariff Legislation | 2 |
| 69c | Advanced Accounting | 2 |
| 69d | General and Life Insurance | 2 |
| 69e | Fire, Accident and Fidelity Insurance | 2 |
| 82 | Greek Oratory | 3 |
| 83 | Thucydides | 2 |
| 103 | Roman Literature | 3 |
| 139 | The Modern German Novel and Drama | 2 |
| 140 | Epochs in German Culture | 2 |
| 155 | Chaucer and Middle English | 2 |
| 189 | Quantitative Analysis | 4 |
| 200 | Technical Chemistry | 2 |
| 261 | Spherical Astronomy | 3 |
| 292 | Railroad Engineering and Location | 3 |
| 295 | Municipal Engineering | 4 |
| 296 | Geodesy | 3 |
| 299 | Concrete Engineering | 2 |
| 300 | Structural Engineering Laboratory | 2 |
| 306 | Engines and Boilers | 3 |
| 310 | Boiler Furnaces, Fuels, Feed Waters, etc. | 1 |
| 311 | Valve Gears and Governors | 2 |
| 314 | Heating and Ventilation | 2 |
| 315 | Compressed Air Machinery | 2 |
| 319 | Steam Laboratory | 1 |
| 320a | Engine and Boiler Tests | 1 |
| 336 | Alternating Current Machinery | 3 |
| 337 | Electrical Illuminating Engineering | 3 |
| 338 | Electrical Railway Engineering | 1 |
| 339 | Electro-Chemistry | 2 |
| 340 | Electrical Laboratory, Advanced | 3 |
| 341 | Electric Illumination and Photometry | 2 |

SENIOR YEAR—SECOND SEMESTER.

| | | |
|-----------|----------------------------|---|
| M. Sur. 6 | Mining Surveying | 2 |
| Min. 8 | Mineralogy and Petrography | 2 |

| NUMBER | SUBJECT | CREDITS |
|-------------|---|---------|
| Min. 16 | Mineralogy and Petrography | 1 to 12 |
| Min. 22 | Physical Mineralogy | 2 to 12 |
| Min. 41 | Chemical Mineralogy | 2 |
| Pet. 6 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 14 | Petrographical Laboratory | 2 |
| Pet. 20 | Petrographical Laboratory | 1 to 12 |
| Met. 12 | Metallurgical Calculations | 2 |
| Met. 18 | The Metallurgy of Steel | 2 |
| Met. 22 | The Metallurgy of Copper | 2 |
| Met. 24 | The Metallurgy of Lead | 2 |
| Met. 27 | The Metallurgy of the Minor Metals | 2 |
| Met. 31 | Hydro-Metallurgy | 2 |
| Met. 35 | Electro-Metallurgy | 2 |
| Met. 39 | Metallurgical Designing | 1 to 12 |
| Met. 45 | Metallurgical Laboratory | 2 |
| Met. 51 | Metallurgical Laboratory | 1 to 12 |
| Met. 55 | Hydro-Metallurgical Laboratory | 2 |
| Met. 59 | Hydro-Metallurgical Laboratory | 1 to 12 |
| Met. 63 | Electro-Metallurgical Laboratory | 2 |
| Met. 67 | Electro-Metallurgical Laboratory | 1 to 12 |
| Met. 73 | Fire Assaying | 2 |
| Met. 79 | Wet Assaying | 2 |
| Met. 87 | Assaying Laboratory | 1 to 12 |
| Ore. 6 | Gold and Silver Milling | 2 |
| Ore. 11 | Coal Washing, etc. | 2 |
| Ore. 17 | Ore Dressing Laboratory | 2 |
| Ore. 23 | Ore Dressing Laboratory | 1 to 12 |
| Ore. 29 | Coal Washing Laboratory | 2 |
| Ore. 35 | Coal Washing Laboratory | 1 to 12 |
| Pal. 8 | Paleontology | 2 |
| Pal. 16 | Paleobotany | 2 |
| Pal. 24 | Paleontological Laboratory | 1 to 12 |
| Pal. 34 | Paleobotanical Laboratory | 1 to 12 |
| Geol. 12 | Azoic or Archæan Geology | 2 |
| Geol. 20 | Prehistoric Man | 2 |
| Geol. 22 | Geology of the United States | 2 |
| Geol. 54 | Geological Laboratory and Field Work | 2 |
| Geol. 62 | Geological Laboratory and Field Work | 1 to 12 |
| M. Geol. 15 | Precious Stones or Gems | 2 |
| M. Geol. 19 | Petroleum, Natural Gas, etc. | 2 |
| M. Geol. 27 | Copper Deposits | 2 |
| M. Geol. 29 | Gold, Silver, and Silver Lead Deposits | 2 |
| M. Geol. 37 | Genesis of Ore Deposits | 2 |

OUTLINE OF STUDIES

31

| NUMBER | SUBJECT | CREDITS |
|-------------|--|---------|
| M. Geol. 43 | Mining Geological Laboratory | 2 to 12 |
| Cer. 16 | Concrete Construction | 2 |
| Cer. 20 | Manufacture of Pottery and Porcelain | 2 |
| Cer. 26 | Ceramic Laboratory | 2 |
| Cer. 32 | Ceramic Laboratory | 1 to 12 |
| Cer. 38 | Laboratory Work in Glass Making | 2 |
| Cer. 42 | Laboratory Work in Glass Making | 1 to 12 |
| Mine. 12 | Mining Engineering | 2 |
| Mine. 16 | "Laying Out" of Mines and Mine Plants | 2 |
| Mine. 24 | Mine Hoisting and Haulage | 2 |
| Mine. 26 | Shaft Sinking | 2 |
| Mine. 27 | Supporting or Timbering | 2 |
| Mine. 28 | Exploitation | 2 |
| Mine. 30 | Mine Accidents—Causes, Prevention, etc. | 2 |
| Mine. 31 | Mine Explosives—Care and Use | 2 |
| Mine. 34 | Mine Labor, Strikes, Legislation, etc. | 2 |
| Mine. 36 | Mining for Petroleum, Natural Gas, Asphaltum, and other Hydro-Carbons | 2 |
| Mine. 49 | Mining Laboratory and Design | 2 |
| Mine. 55 | Mining Laboratory and Design | 1 to 12 |
| Mine. 68 | Electricity Applied to Mining | 2 |
| Law 4 | Advanced Mining Law | 2 |
| Law 6 | Law Relating to Oil and Gas | 2 |
| 41 | Educational Psychology | 2 |
| 43 | History of Education | 2 |
| 54 | The Political and Constitutional History of U. S. | 3 |
| 55a | Constitutional History of England | 3 |
| 59c | History of Political Theories | 2 |
| 68 | Public Finance | 2 |
| 69 | Business Law | 2 |
| 69c | Advanced Accounting | 2 |
| 69d | General and Life Insurance | 2 |
| 69e | Fire, Accident, and Fidelity Insurance | 2 |
| 103 | Roman Literature | 3 |
| 139 | The Modern German Novel and Drama | 2 |
| 141 | German Romanticism | 2 |
| 157b | Victorian Literature | 3 |
| 156 | Spencer and Milton | 2 |
| 200 | Technical Chemistry | 2 |
| 201 | Chemical German | 2 |
| 202 | Calorimetry | 2 |
| 236 | Municipal Sanitation | 2 |
| 278 | Manufacture and Properties of Steel | 4 |

| NUMBER | SUBJECT | CREDITS |
|--------|--|---------|
| 290b | Structural Engineering | 4 |
| 292a | Railroad Engineering and Construction | 2 |
| 293 | Arches and Retaining Walls | 2 |
| 294 | Roads and Pavement | 2 |
| 297 | Contracts and Specifications | 2 |
| 301 | Engineering Practice | 3 |
| 312 | Steam Turbines | 2 |
| 313 | Gas Engines and Producers | 3 |
| 316 | Installation of Steam Power Plants | 3 |
| 320 | Power Plant Testing | 1 |
| 336 | Alternating Current Machinery | 3 |
| 340 | Electrical Transmission and Distribution | 3 |
| 342 | Electric Railway and Power Plants | 2 |

SENIOR YEAR—SUMMER VACATION.

FOUR TO TWELVE WEEKS.

| | | |
|-------------|--|---------|
| M. Sur. 10 | Practical Work in Surveying | 6 to 18 |
| Min. 30 | Practical Work in Mineralogy | 6 to 18 |
| Pet. 25 | Practical Work in Petrography | 6 to 18 |
| Met. 91 | Practical Work in Metallurgy | 6 to 18 |
| Met. 95 | Practical Work in Assaying | 6 to 18 |
| Met. 98 | Practical Work in Hydro-Metallurgy | 6 to 18 |
| Met. 101 | Practical Work in Electro-Metallurgy | 6 to 18 |
| Ore. 43 | Practical Work in Ore Dressing | 6 to 18 |
| Ore. 47 | Practical Work in Coal Washing, etc. | 6 to 18 |
| Pal. 40 | Practical Work in Paleontology | 6 to 18 |
| Pal. 45 | Practical Work in Paleobotany | 6 to 18 |
| Geol. 68 | Practical Work in Geology | 6 to 18 |
| M. Geol. 49 | Practical Work in Mining Geology | 6 to 18 |
| Cer. 47 | Practical Work in Ceramics | 6 to 18 |
| Cer. 51 | Practical Work in the Manufacture of Brick, Tile, Terra Cotta, etc. | 6 to 18 |
| Cer. 54 | Practical Work in Limes, Plasters, and Cements | 6 to 18 |
| Cer. 58 | Practical Work in Cement Manufacture | 6 to 18 |
| Cer. 61 | Practical Work in Concrete Construction | 6 to 18 |
| Cer. 64 | Practical Work in Glass Making | 6 to 18 |
| Mine. 61 | Practical Work in Mining | 6 to 18 |

GRADUATE YEARS—FIRST SEMESTER.

| | | |
|------------|-----------------------------------|---------|
| M. Sur. 12 | Research Work in Mining Surveying | 2 to 20 |
| M. Sur. 14 | Education in Mining Surveying | 2 to 20 |
| M. Sur. 16 | History of Mining Surveying | 2 to 20 |
| Min. 23 | Mineralogy of the United States | 2 to 20 |

OUTLINE OF STUDIES

33

| NUMBER | SUBJECT | CREDITS |
|----------|---|---------|
| Min. 25 | Mineralogy of Pennsylvania | 2 to 20 |
| Min. 32 | Research Work in Crystallography | 2 to 20 |
| Min. 34 | Research Work in Determinative Mineralogy | 2 to 20 |
| Min. 42 | Research Work in Physical Mineralogy | 2 to 20 |
| Min. 44 | Research Work in Chemical Mineralogy | 2 |
| Min. 46 | Mineralogical Education | 2 to 20 |
| Min. 48 | History of Mineralogy | 2 to 20 |
| Pet. 7 | Research Work in Microscopical Petrography | 2 |
| Pet. 21 | Petrographical Laboratory | 2 to 20 |
| Pet. 27 | Research Work in Petrography of the Coal Measures | 2 to 20 |
| Pet. 29 | Research Work upon the Petrography of Pennsylvania | 2 to 20 |
| Pet. 31 | Research Work upon the Petrography of the United States | 2 to 20 |
| Pet. 33 | Research Work in Optical and Microscopical Mineralogy | 2 to 20 |
| Pet. 35 | Petrographical Education | 2 to 20 |
| Pet. 37 | History of Petrography | 2 to 20 |
| Met. 80 | Wet Assaying | 2 to 20 |
| Met. 103 | Research Work in Metallurgy | 2 to 20 |
| Met. 105 | Research Work in Assaying | 2 to 20 |
| Met. 107 | Research Work in Hydro-Metallurgy | 2 to 20 |
| Met. 109 | Research Work in Electro-Metallurgy | 2 to 20 |
| Met. 111 | Metallurgical Education | 2 to 20 |
| Met. 113 | History of Metallurgy | 2 to 20 |
| Ore. 36 | Research Work in Ore Dressing | 2 to 20 |
| Ore. 38 | Research Work in Coal Washing | 2 to 20 |
| Ore. 48 | Research Work in Gold and Silver Milling | 2 to 20 |
| Ore. 51 | Education in Ore Dressing | 2 to 20 |
| Ore. 53 | History of Ore Dressing | 2 to 20 |
| Ore. 56 | Education in Coal Washing | 2 to 20 |
| Ore. 57 | History of Coal Washing | 2 to 20 |
| Pal. 25 | Paleontological Laboratory | 2 to 20 |
| Pal. 35 | Paleobotanical Laboratory | 2 to 20 |
| Pal. 47 | Research Work in Paleontology | 2 to 20 |
| Pal. 49 | Research Work in Paleobotany | 2 to 20 |
| Pal. 51 | Research Work in Invertebrate Paleontology | 2 to 20 |
| Pal. 53 | Research Work in Vertebrate Paleontology | 2 to 20 |
| Pal. 55 | Research Work in the Paleozoic Flora | 2 to 20 |
| Pal. 57 | Research Work in the Mesozoic and Cenozoic Flora | 2 to 20 |
| Pal. 59 | Research Work in Pennsylvania Paleontology | 2 to 20 |

| NUMBER | SUBJECT | CREDITS |
|-------------|--|---------|
| Pal. 61 | Research Work in Pennsylvania Paleobotany | 2 to 20 |
| Pal. 63 | Paleontological Education | 2 to 20 |
| Pal. 65 | History of Paleontology | 2 to 20 |
| Pal. 67 | Paleobotanical Education | 2 to 20 |
| Pal. 69 | History of Paleobotany | 2 to 20 |
| Geol. 23 | Geology of Pennsylvania | 2 to 20 |
| Geol. 25 | The Philosophy of Geology | 2 |
| Geol. 27 | History of Geology and Paleontology | 2 |
| Geol. 29 | Research Work in Physical Geography or Physiographic Geology | 2 to 20 |
| Geol. 31 | Volcanoes and Earthquakes | 2 to 20 |
| Geol. 33 | Research Work in Physical Geology | 2 to 20 |
| Geol. 35 | Research Work in Azoic or Archaean Geology | 2 to 20 |
| Geol. 37 | Research Work in Stratigraphical or Historical Geology | 2 to 20 |
| Geol. 39 | Research Work in Glacial Geology | 2 to 20 |
| Geol. 41 | Prehistoric Man | 2 to 20 |
| Geol. 43 | Research Work in the Geology of the United States | 2 to 20 |
| Geol. 45 | Research Work in Chemical Geology | 2 to 20 |
| Geol. 63 | Geological Laboratory and Field Work | 2 to 20 |
| Geol. 70 | Research Work in Geology | 2 to 20 |
| Geol. 73 | Geological Education | 2 to 20 |
| M. Geol. 20 | Research Work in the Geology of Mineral Fertilizers | 2 to 20 |
| M. Geol. 24 | Research Work in the Geology of Saline Materials | 2 to 20 |
| M. Geol. 30 | Research Work upon Lead and Zinc Deposits | 2 to 20 |
| M. Geol. 32 | Research Work upon Deposits of Chromium, Bismuth, Nickel, etc. | 2 to 20 |
| M. Geol. 34 | Research Work upon the Mining Geology of Pennsylvania | 2 to 20 |
| M. Geol. 44 | Mining Geological Laboratory | 2 to 20 |
| M. Geol. 51 | Research Work in Mining Geology | 2 to 20 |
| M. Geol. 53 | Research Work upon the Ore Deposits of Europe, etc. | 2 to 20 |
| M. Geol. 55 | Research Work upon Abrasives and Refractory Materials | 2 to 20 |
| M. Geol. 57 | Research Work upon Building and Ornamental Stones | 2 to 20 |
| M. Geol. 59 | Research Work upon Clays and Clay Deposits | 2 to 20 |
| M. Geol. 61 | Research Work in Limes, Plasters, and Cements | 2 to 20 |
| M. Geol. 63 | Research Work upon Coal—Its Origin, Occurrence, etc. | 2 to 20 |

OUTLINE OF STUDIES

35

| NUMBER | SUBJECT | CREDITS |
|-------------|---|---------|
| M. Geol. 65 | Research Work upon the Geology and Uses of Water | 2 to 20 |
| M. Geol. 67 | Research Work upon the Geology of Pigments, Mineral Medicines, etc. | 2 to 20 |
| M. Geol. 69 | Research Work upon Tin and Mercury Deposits | 2 to 20 |
| M. Geol. 71 | Research Work upon Deposits of Aluminum, Sulphur, Vanadium, etc. | 2 to 20 |
| M. Geol. 73 | Research Work upon Petroleum and Natural Gas Deposits | 2 to 20 |
| M. Geol. 75 | Research Work upon Gems, their Origin, Occurrence, etc. | 2 to 20 |
| M. Geol. 77 | Research Work upon Asphaltum and other Hydro-Carbon Deposits | 2 to 20 |
| M. Geol. 79 | Research Work upon Iron and Manganese Deposits | 2 to 20 |
| M. Geol. 81 | Research Work upon Copper Deposits | 2 to 20 |
| M. Geol. 83 | Research Work upon Gold, Silver, and Silver Lead Deposits | 2 to 20 |
| M. Geol. 85 | Research Work upon the Genesis of Memetal-lites or Non-Metalliferous Deposits | 2 to 20 |
| M. Geol. 87 | Research Work upon the Genesis of Metallites or Ore Deposits | 2 to 20 |
| M. Geol. 89 | Education in Mining Geology | 2 to 20 |
| M. Geol. 91 | History of Mining Geology | 2 to 20 |
| Cer. 33 | Ceramic Laboratory | 2 to 20 |
| Cer. 43 | Laboratory Work in Glass Making, etc. | 2 to 20 |
| Cer. 67 | Research Work in Ceramics | 2 to 20 |
| Cer. 69 | Research Work in the Manufacture of Brick, Tile, Terra Cotta, etc. | 2 to 20 |
| Cer. 71 | Research Work in the Manufacture of Pottery and Porcelain | 2 to 20 |
| Cer. 73 | Research Work in Cement Manufacture | 2 to 20 |
| Cer. 75 | Research Work in Concrete Manufacture | 2 to 20 |
| Cer. 77 | Research Work in Glass Making | 2 to 20 |
| Cer. 79 | Research Work in Clay Working | 2 to 20 |
| Cer. 81 | Research Work in Clay Testing | 2 to 20 |
| Cer. 83 | Ceramic Education | 2 to 20 |
| Cer. 85 | History of Ceramics | 2 to 20 |
| Mine. 40 | Deep Mining—Ventilation, Heat, etc. | 2 to 20 |
| Mine. 42 | Advanced Mining Engineering | 2 to 20 |
| Mine. 56 | Mining Laboratory and Design | 2 to 20 |
| Mine. 63 | Research Work in Mining | 2 to 20 |
| Mine. 69 | Research Work in Coal Mining | 2 to 20 |

| NUMBER | SUBJECT | CREDITS |
|---------------------------------|---|---------|
| Mine. 71 | Research Work in Metal Mining | 2 to 20 |
| Mine. 73 | Research Work in Mine Gases | 2 to 20 |
| Mine. 75 | Research Work in Mine Ventilation | 2 to 20 |
| Mine. 77 | Research Work in Mine Illumination | 2 to 20 |
| Mine. 79 | Research Work in Mine Machinery | 2 to 20 |
| Mine. 81 | Research Work in Power Generation and Transmission | 2 to 20 |
| Mine. 83 | Research Work in Mine Drainage and Pumping | 2 to 20 |
| Mine. 85 | Research Work in Mine Hoisting and Haulage | 2 to 20 |
| Mine. 87 | Research Work in Drilling, Boring, Excavating, etc. | 2 to 20 |
| Mine. 89 | Research Work in Shaft Sinking | 2 to 20 |
| Mine. 91 | Research Work in Mine Supporting or Timber- ing | 2 to 20 |
| Mine. 93 | Research Work in Mine Exploitation | 2 to 20 |
| Mine. 95 | Research Work in Mine Prospecting, Sampling, Valuation, etc. | 2 to 20 |
| Mine. 97 | Research Work upon Mine Accidents, Their Causes, Prevention, etc. | 2 to 20 |
| Mine. 99 | Research Work in Mining for Petroleum, Nat- ural Gas and other Hydro-Carbons | 2 to 20 |
| Mine. 101 | Research Work upon Mine Timbers and other Mine Supports | 2 to 20 |
| Mine. 103 | Research Work in Hydraulic Mining and Dredging | 2 to 20 |
| Mine. 105 | Research Work upon the Application of Elec- tricity to Mining | 2 to 20 |
| Mine. 107 | Stone Quarrying and Open Work Mining | 2 to 20 |
| Mine. 109 | Mining Education | 2 to 20 |
| Mine. 111 | History of Mining | 2 to 20 |
| Law 7 | Introduction to American Law, Contracts, Frauds, etc. | 2 to 20 |
| Law 9 | Negligence and Personal Injuries in Mines | 2 to 20 |
| Law 11 | The Law of Mining Operations | 2 to 20 |
| Law 13 | Mining Laws of Great Britain | 2 to 20 |
| Law 15 | Mining Laws of Mexico, etc. | 2 to 20 |
| Law 17 | Critical Study of Mining Law | 2 to 20 |
| Law 19 | Education in Mining Law | 2 to 20 |
| Law 21 | History of Mining Law | 2 to 20 |
| GRADUATE YEARS—SECOND SEMESTER. | | |
| M. Sur. 13 | Research Work in Mining Surveying | 2 to 20 |
| M. Sur. 15 | Education in Mining Surveying | 2 to 20 |

OUTLINE OF STUDIES

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| NUMBER | SUBJECT | CREDITS |
|------------|---|---------|
| M. Sur. 17 | History of Mining Surveying | 2 to 20 |
| Min. 24 | Mineralogy of the United States | 2 to 20 |
| Min. 25 | Mineralogy of Pennsylvania | 2 to 20 |
| Min. 32 | Research Work in Crystallography | 2 to 20 |
| Min. 34 | Research Work in Determinative Mineralogy | 2 to 20 |
| Min. 43 | Research Work in Physical Mineralogy | 2 to 20 |
| Min. 45 | Research Work in Chemical Mineralogy | 2 to 20 |
| Min. 47 | Mineralogical Education | 2 to 20 |
| Min. 49 | History of Crystallography and Mineralogy | 2 to 20 |
| Pet. 8 | Research Work in Petrography | 2 to 20 |
| Pet. 22 | Petrographical Laboratory | 2 to 20 |
| Pet. 28 | Research Work in Petrography of the Coal Measures | 2 to 20 |
| Pet. 30 | Research work upon the Petrography of Pennsylvania | 2 to 20 |
| Pet. 32 | Research Work upon the Petrography of the United States | 2 to 20 |
| Pet. 34 | Research Work in Optical and Microscopical Petrography | 2 to 20 |
| Pet. 36 | Petrographical Education | 2 to 20 |
| Pet. 38 | History of Petrography | 2 to 20 |
| Met. 81 | Wet Assaying | 2 to 20 |
| Met. 104 | Research Work in Metallurgy | 2 to 20 |
| Met. 106 | Research Work in Assaying | 2 to 20 |
| Met. 108 | Research Work in Hydro-Metallurgy | 2 to 20 |
| Met. 110 | Research Work in Electro-Metallurgy | 2 to 20 |
| Met. 112 | Metallurgical Education | 2 to 20 |
| Met. 114 | History of Metallurgy | 2 to 20 |
| Ore. 37 | Research Work in Ore Dressing | 2 to 20 |
| Ore. 39 | Research Work in Coal Washing, etc. | 2 to 20 |
| Ore. 49 | Research Work in Gold and Silver Milling | 2 to 20 |
| Ore. 52 | Education in Ore Dressing | 2 to 20 |
| Ore. 54 | History of Ore Dressing | 2 to 20 |
| Ore. 56 | Education in Coal Washing | 2 to 20 |
| Ore. 58 | History of Coal Washing | 2 to 20 |
| Pal. 26 | Paleontological Laboratory | 2 to 20 |
| Pal. 36 | Paleobotanical Laboratory | 2 to 20 |
| Pal. 48 | Research Work in Paleontology | 2 to 20 |
| Pal. 50 | Research Work in Paleobotany | 2 to 20 |
| Pal. 52 | Research Work in Invertebrate Paleontology | 2 to 20 |
| Pal. 54 | Research Work in Vertebrate Paleontology | 2 to 20 |
| Pal. 56 | Research Work in the Paleozoic Flora | 2 to 20 |

| NUMBER | SUBJECT | CREDITS |
|-------------|---|---------|
| Pal. 58 | Research Work in the Mesozoic and Cenozoic Flora | 2 to 20 |
| Pal. 60 | Research Work in Pennsylvania Paleontology | 2 to 20 |
| Pal. 62 | Research Work in Pennsylvania Paleobotany | 2 to 20 |
| Pal. 64 | Paleontological Education | 2 to 20 |
| Pal. 66 | History of Paleontology | 2 to 20 |
| Pal. 68 | Paleobotanical Education | 2 to 20 |
| Pal. 70 | History of Paleobotany | 2 to 20 |
| Geol. 24 | Geology of Pennsylvania | 2 to 20 |
| Geol. 26 | The Philosophy of Geology | 2 |
| Geol. 28 | History of Geology and Paleontology | 2 |
| Geol. 30 | Research Work in Physical Geography or Physio- graphic Geology | 2 to 20 |
| Geol. 32 | Volcanoes and Earthquakes | 2 to 20 |
| Geol. 34 | Research Work in Physical Geology | 2 to 20 |
| Geol. 36 | Research Work in Azoic or Archaean Geology | 2 to 20 |
| Geol. 38 | Research Work in Stratigraphical or Historical Geology | 2 to 20 |
| Geol. 40 | Research Work in Glacial Geology | 2 to 20 |
| Geol. 42 | Prehistoric Man | 2 to 20 |
| Geol. 44 | Research Work in the Geology of the United States | 2 to 20 |
| Geol. 46 | Research Work in Chemical Geology | 2 to 20 |
| Geol. 64 | Geological Laboratory and Field Work | 2 to 20 |
| Geol. 71 | Research Work in Geology | 2 to 20 |
| Geol. 74 | Geological Education | 2 to 20 |
| M. Geol. 21 | Research Work in the Geology of Mineral Fertilizers | 2 to 20 |
| M. Geol. 25 | Research Work in the Geology of Saline Materials | 2 to 20 |
| M. Geol. 31 | Research Work upon Lead and Zinc Deposits | 2 to 20 |
| M. Geol. 33 | Research Work upon Deposits of Chromium, Bismuth, Nickel, etc. | 2 to 20 |
| M. Geol. 35 | Research Work upon the Mining Geology of Pennsylvania | 2 to 20 |
| M. Geol. 45 | Mining Geological Laboratory | 2 to 20 |
| M. Geol. 52 | Research Work in Mining Geology | 2 to 20 |
| M. Geol. 54 | Research Work upon the Ore Deposits of Europe, Africa, etc. | 2 to 20 |
| M. Geol. 56 | Research Work upon Abrasives and Refractory Materials | 2 to 20 |
| M. Geol. 58 | Research Work upon Building and Ornamental Stones | 2 to 20 |

OUTLINE OF STUDIES

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| NUMBER | SUBJECT | CREDITS |
|-------------|---|---------|
| M. Geol. 60 | Research Work upon Clays and Clay Deposits | 2 to 20 |
| M. Geol. 62 | Research Work upon Limes, Plasters, and Cements | 2 to 20 |
| M. Geol. 64 | Research Work upon Coal, its Origin, Occur- rence, etc. | 2 to 20 |
| M. Geol. 66 | Research Work upon the Geology and Uses of Water | 2 to 20 |
| M. Geol. 68 | Research Work upon the Geology of Pigments, Mineral Medicines, etc. | 2 to 20 |
| M. Geol. 70 | Research Work upon Tin and Mercury Deposits | 2 to 20 |
| M. Geol. 72 | Research Work upon Deposits of Aluminim, Sulphur, Vanadium, etc. | 2 to 20 |
| M. Geol. 74 | Research Work upon Petroleum and Natural Gas Deposits | 2 to 20 |
| M. Geol. 76 | Research Work upon Gems, their Origin, Occurrence, etc. | 2 to 20 |
| M. Geol. 78 | Research Work upon Asphaltum and other Hydro-Carbon Deposits | 2 to 20 |
| M. Geol. 80 | Research Work upon Iron and Manganese Deposits | 2 to 20 |
| M. Geol. 82 | Research Work upon Copper Deposits | 2 to 20 |
| M. Geol. 84 | Research Work upon Gold, Silver, and Silver Lead Deposits | 2 to 20 |
| M. Geol. 86 | Research Work on the Genesis of Memetal- lites or Non-Metalliferous Deposits | 2 to 20 |
| M. Geol. 88 | Research Work upon the Genesis of Metallites or Ore Deposits | 2 to 20 |
| M. Geol. 90 | Education in Mining Geology | 2 to 20 |
| M. Geol. 92 | History of Mining Geology | 2 to 20 |
| Cer. 34 | Ceramic Laboratory | 2 to 20 |
| Cer. 44 | Laboratory Work in Glass Making | 2 to 20 |
| Cer. 68 | Research Work in Ceramics | 2 to 20 |
| Cer. 69 | Research Work in Manufacture of Brick, Tile, Terra Cotta, etc. | 2 to 20 |
| Cer. 72 | Research Work in Manufacture of Pottery and Porcelain | 2 to 20 |
| Cer. 74 | Research Work in Cement Manufacture | 2 to 20 |
| Cer. 76 | Research Work in Concrete Manufacture | 2 to 20 |
| Cer. 78 | Research Work in Glass Making | 2 to 20 |
| Cer. 80 | Research Work in Clay Working | 2 to 20 |
| Cer. 82 | Research Work in Clay Testing | 2 to 20 |
| Cer. 84 | Ceramic Education | 2 to 20 |
| Cer. 86 | History of Ceramics | 2 to 20 |

| NUMBER | SUBJECT | CREDITS |
|-----------|---|---------|
| Mine. 41 | Deep Mining—Hoisting from Great Depths | 2 to 20 |
| Mine. 43 | Advanced Mining Engineering | 2 to 20 |
| Mine. 57 | Mining Laboratory and Design | 2 to 20 |
| Mine. 64 | Research Work in Mining | 2 to 20 |
| Mine. 70 | Research Work in Coal Mining | 2 to 20 |
| Mine. 72 | Research Work in Metal Mining | 2 to 20 |
| Mine. 74 | Research Work in Mine Gases | 2 to 20 |
| Mine. 76 | Research Work in Mine Ventilation | 2 to 20 |
| Mine. 78 | Research Work in Mine Illumination | 2 to 20 |
| Mine. 80 | Research Work in Mine Machinery | 2 to 20 |
| Mine. 82 | Research Work in Power Generation and Transmission | 2 to 20 |
| Mine. 84 | Research Work in Mine, Drainage and Pumping | 2 to 20 |
| Mine. 86 | Research Work in Mine Hoisting and Haulage | 2 to 20 |
| Mine. 88 | Research Work in Drilling, Boring, Excavation, etc. | 2 to 20 |
| Mine. 90 | Research Work in Shaft Sinking | 2 to 20 |
| Mine. 92 | Research Work in Mine Supporting or Timbering | 2 to 20 |
| Mine. 94 | Research Work in Mine Exploitation | 2 to 20 |
| Mine. 96 | Research Work in Mine Prospecting, Sampling, Valuation, etc. | 2 to 20 |
| Mine. 98 | Research Work upon Mine Accidents, their Causes, Prevention, etc. | 2 to 20 |
| Mine. 100 | Research Work in Mining for Petroleum, Natural Gas and other Hydro-Carbons | 2 to 20 |
| Mine. 102 | Research Work upon Mine Timbers and other Mine Supports | 2 to 20 |
| Mine. 104 | Research Work in Hydraulic Mining and Dredging | 2 to 20 |
| Mine. 106 | Research Work upon the Applications of Electricity to Mining | 2 to 20 |
| Mine. 108 | Stone Quarrying and Open Work Mining | 2 to 20 |
| Mine. 110 | Mining Education | 2 to 20 |
| Mine. 112 | History of Mining | 2 to 20 |
| Law 8 | American Law, Contracts, Limitations, etc. | 2 |
| Law 10 | Law of Negligence and Mining Injuries | 2 |
| Law 12 | Law of Mining Operations | 2 |
| Law 14 | Mining Laws of Great Britain | 2 |
| Law 16 | Mining Laws of Mexico, etc. | 2 |
| Law 18 | Critical Study of Mining Law | 2 to 20 |
| Law 20 | Education in Mining Law | 2 to 20 |
| Law 22 | History of Mining Law | 2 to 20 |

OUTLINE OF STUDIES

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GRADUATE YEARS—SUMMER VACATION.

FOUR TO TWELVE WEEKS.

| | | |
|-------------|--|---------|
| M. Sur. 11 | Practical Work in Surveying | 6 to 18 |
| Min. 31 | Practical Work in Mineralogy | 6 to 18 |
| Pet. 26 | Practical Work in Petrography | 6 to 18 |
| Met. 92 | Practical Work in Metallurgy | 6 to 18 |
| Met. 96 | Practical Work in Assaying | 6 to 18 |
| Met. 99 | Practical Work in Hydro-Metallurgy | 6 to 18 |
| Met. 102 | Practical Work in Electro-Metallurgy | 6 to 18 |
| Ore. 43 | Practical Work in Ore Dressing | 6 to 18 |
| Ore. 47 | Practical Work in Coal Washing, etc. | 6 to 18 |
| Ore. 50 | Practical Work in Gold and Silver Milling | 6 to 18 |
| Pal. 41 | Practical Work in Paleontology | 6 to 18 |
| Pal. 46 | Practical Work in Paleobotany | 6 to 18 |
| Geol. 69 | Practical Work in Geology | 6 to 18 |
| M. Geol. 50 | Practical Work in Mining Geology | 6 to 18 |
| Cer. 48 | Practical Work in Ceramics | 6 to 18 |
| Cer. 53 | Practical Work in the Manufacture of Brick, Tile, Terra Cotta, etc. | 6 to 18 |
| Cer. 56 | Practical Work in Limes, Plasters, and Cements | 6 to 18 |
| Cer. 59 | Practical Work in Cement Manufacture | 6 to 18 |
| Cer. 53 | Practical Work in Concrete Construction | 6 to 18 |
| Cer. 66 | Practical Work in Glass Making | 6 to 18 |
| Mine. 62 | Practical Work in Mining | 6 to 18 |

WORK IN THE SCHOOL OF MINES

The work offered in the School of Mines is described more or less in detail in the following pages. The subjects are arranged in groups, to which reference is made in the schedules of studies under the following abbreviations:

| GROUP NAME | REFERENCE ABBREVIATION |
|---------------------------------------|------------------------|
| 1. Ceramics | Cer. |
| 2. Geology | Geol. |
| 3. Metallurgy | Met. |
| 4. Mineralogy | Min. |
| 5. Mining | Mine. |
| 6. Mining Geology..... | M. Geol. |
| 7. Mining Law..... | Law |
| 8. Mining Surveying..... | M. Sur. |
| 9. Ore Dressing and Coal Washing..... | Ore. |
| 10. Paleontology | Pal. |
| 11. Petrography | Pet. |

Subjects taught in the class rooms and laboratories of other schools belonging to the University will be found described in the University Catalog under the respective departments to which they belong.

I. CERAMICS.

Cer. 1. Clay Testing.

Preparation required: 185, 186, 194; Min. 1, 2; Geol. 5, 6; M. Geol. 1, 2. Taken with 187, 210; M. Geol. 9; Cer. 21.
Sophomore Year, First Semester, 2 Credits.

Cer. 2. Clay Mining and Manufactures.

Preparation required: Cer. 1. Taken with 187, 210; Cer. 22; M. Geol. 10.
Sophomore Year, Second Semester, 2 credits.

Cer. 3. Manufacture, Properties, Tests, and Uses of Bricks, Tiles, Terra Cotta, etc.

Preparation required: M. Geol. 1, 2. Taken with 187, 210; M. Geol. 9; Cer. 1, 21.
Sophomore Year, First Semester, 2 credits.

Cer. 4. Manufacture, Properties, Tests, and Uses of Bricks, Tiles, Terra Cotta, etc.

Preparation required: Cer. 1, 3, 21. Taken with 187, 210; Cer. 2; M. Geol. 10.
Sophomore Year, Second Semester, 2 credits.

Cer. 5. Manufacture, Properties, Tests, and Uses of Limes, Plasters, and Cements.

Preparation required: 185, 186, 194; Min. 1, 2; Geol. 5, 6; M. Geol. 1, 2. Taken with 187, 210; M. Geol. 11; Cer. 21.
Sophomore Year, First Semester, 2 credits.

Cer. 6. Manufacture, Properties, Tests, and Uses of Limes, Plasters, and Cements.

Preparation required: Cer. 5. Taken with 187, 210; Cer. 22; M. Geol. 12.
Sophomore Year, Second Semester, 2 credits.

Cer. 7. Glazes, Enamels, and Colors.

Preparation required: 185, 186, 187, 194, 210; M. Geol. 13. Taken with 188; Cer. 23.
Junior Year, First Semester, 2 credits.

Cer. 8. Glazes, Enamels, and Colors.

Preparation required: Cer. 7. Taken with 188; Cer. 24.
Junior Year, Second Semester, 2 credits.

Cer. 9. Manufacture of Glass.

Preparation required: 185, 186, 187, 194; M. Geol. 13. Taken with 188; Cer. 35.
Junior Year, First Semester, 2 credits.

Cer. 10. Manufacture of Glass.

Preparation required: Cer. 9. Taken with 188.

Junior Year, Second Semester, 2 credits.

Cer. 11. Ceramic Calculations.

Preparation required: 185, 186, 187, 194. Taken with Cer. 7 or 9.

Junior Year, First Semester, 2 credits.

Cer. 12. Ceramic Construction.

Preparation required: Cer. 1, 2, 3, 4, 7. Taken with Cer. 8.

Junior Year, Second Semester, 2 credits.

Cer. 13. Manufacture, Properties, Tests, and Uses of Cements.

Preparation required: 185, 186, 187, 194, 210; Cer. 5, 6. Taken with 188; Cer. 23.

Junior Year, First Semester, 2 credits.

Cer. 14. Manufacture, Properties, Tests, and Uses of Cements.

Preparation required: Cer. 13. Taken with 188; Cer. 24.

Junior Year, Second Semester, 2 credits.

Cer. 15. Concrete—Its Properties, Tests, and Uses.

Preparation required: Cer. 14. Taken with Cer. 25.

Senior Year, First Semester, 2 credits.

Cer. 16. Concrete Construction.

Preparation required: Cer. 15; M. Geol. 4. Taken with Cer. 26.

Senior Year, Second Semester, 2 credits.

Cer. 17. Manufacture, Properties, Tests, and Uses of Fire Brick.

Preparation required: Cer. 1, 2, 3, 4. Taken with 188; Cer. 23.

Junior Year, First Semester, 2 credits.

Cer. 18. Manufacture of Limes, Plasters, Sand-Lime-Bricks, etc.

Preparation required: Cer. 5, 6, 17. Taken with 188; Cer. 24.

Junior Year, Second Semester, 2 credits.

Cer. 19. Manufacture and Properties of Pottery and Porcelain.

Preparation required: 188; Cer. 8, 11, 12. Taken with Cer. 25.

Senior Year, First Semester, 2 credits.

Cer. 20. Manufacture and Properties of Pottery and Porcelain.

Preparation required: Cer. 19. Taken with Cer. 26.

Senior Year, Second Semester, 2 credits.

Cer. 21. Ceramic Laboratory.

Taken with Cer. 1, or 3, or 5.

Sophomore Year, First Semester, 2 credits.

Cer. 22. Ceramic Laboratory.

Preparation required: Cer. 21. Taken with Cer. 2, or 4, or 6.

Sophomore Year, Second Semester, 2 credits.

Cer. 23. Ceramic Laboratory.

Preparation required: Cer. 22. Taken with Cer. 7, or 13, or 17.

Junior Year, First Semester, 2 credits.

Cer. 24. Ceramic Laboratory.

Preparation required: Cer. 23. Taken with Cer. 8, or 12, or 14, or 18.
Junior Year, Second Semester, 2 credits.

Cer. 25. Ceramic Laboratory.

Preparation required: Cer. 24. Taken with Cer. 15 or 19.
Senior Year, First Semester, 2 credits.

Cer. 26. Ceramic Laboratory.

Preparation required: Cer. 25. Taken with Cer. 16 or 20.
Senior Year, Second Semester, 2 credits.

Cer. 27. Ceramic Laboratory.

Taken with Cer. 21.
Sophomore Year, First Semester, 1 to 12 credits.

Cer. 28. Ceramic Laboratory.

Taken with Cer. 22.
Sophomore Year, Second Semester, 1 to 12 credits.

Cer. 29. Ceramic Laboratory.

Taken with Cer. 23.
Junior Year, First Semester, 1 to 12 credits.

Cer. 30. Ceramic Laboratory.

Taken with Cer. 24.
Junior Year, Second Semester, 1 to 12 credits.

Cer. 31. Ceramic Laboratory.

Taken with Cer. 25.
Senior Year, First Semester, 1 to 12 credits.

Cer. 32. Ceramic Laboratory.

Taken with Cer. 26.
Senior Year, Second Semester, 1 to 12 credits.

Cer. 33. Ceramic Laboratory.

Preparation required; Cer. 16 or 20.
Graduate Work, First Semester, 2 to 20 credits.

Cer. 34. Ceramic Laboratory.

Preparation required: Cer. 33.
Graduate Work, Second Semester, 2 to 20 credits.

Work in the Ceramic laboratory is intended to cover fully the chemistry and manufacture of ceramic materials.

Cer. 35. Laboratory Work in Glass Making and Manipulation.

Taken with Cer. 9.
Junior Year, First Semester, 2 credits.

Cer. 36. Laboratory Work in Glass Making and Manipulation.

Preparation required: Cer. 35. Taken with Cer. 10.
Junior Year, Second Semester, 2 credits.

Cer. 37. Laboratory Work in Glass Making and Manipulation.

Preparation required: Cer. 36.
Senior Year, First Semester, 2 credits.

- Cer. 38. Laboratory Work in Glass Making and Manipulation.
Preparation required: Cer. 37.
Senior Year, Second Semester, 2 credits.
- Cer. 39. Laboratory Work in Glass Making and Manipulation.
Taken with Cer. 35.
Junior Year, First Semester, 1 to 12 credits.
- Cer. 40. Laboratory Work in Glass Making and Manipulation.
Taken with Cer. 36.
Junior Year, Second Semester, 1 to 12 credits.
- Cer. 41. Laboratory Work in Glass Making and Manipulation.
Taken with Cer. 37.
Senior Year, First Semester, 1 to 12 credits.
- Cer. 42. Laboratory Work in Glass Making and Manipulation.
Taken with Cer. 38.
Senior Year, Second Semester, 1 to 12 credits.
- Cer. 43. Laboratory Work in Glass Making and Manipulation.
Preparation required: Cer. 38.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 44. Laboratory Work in Glass Making and Manipulation.
Preparation required: Cer. 43.
Graduate Work, Second Semester, 2 to 20 credits.
- Cer. 45. Practical Work in Ceramics.
Preparation required: Cer. 1, 2.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Cer. 46. Practical Work in Ceramics.
Preparation required: Cer. 45.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Cer. 47. Practical Work in Ceramics.
Preparation required: Cer. 46.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Cer. 48. Practical Work in Ceramics.
Preparation required: Cer. 47.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Cer. 49. Practical Work in the Manufacture of Brick, Tile, Terra Cotta, etc.
Preparation required: Cer. 3, 4.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Cer. 50. Practical Work in the Manufacture of Brick, Tile, Terra Cotta, etc.
Preparation required: Cer. 49.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 51. Practical Work in the Manufacture of Brick, Tile, Terra Cotta, etc.

Preparation required: Cer. 50.

Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 52. Practical Work in the Manufacture of Brick, Tile, Terra Cotta, etc.

Preparation required: Cer. 51.

Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 53. Practical Work in Limes, Plasters, and Cements.

Preparation required: Cer. 5, 6.

Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 54. Practical Work in Limes, Plasters, and Cements.

Preparation required: Cer. 53.

Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 55. Practical Work in Limes, Plasters, and Cements.

Preparation required: Cer. 54.

Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 56. Practical Work in Limes, Plasters, and Cements.

Preparation required: Cer. 55.

Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 57. Practical Work in Cement Manufacture.

Preparation required: Cer. 5, 6.

Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 58. Practical Work in Cement Manufacture.

Preparation required: Cer. 13, 14, 57.

Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 59. Practical Work in Cement Manufacture.

Preparation required: Cer. 58.

Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 60. Practical Work in Cement Manufacture.

Preparation required: Cer. 59, 72, 73.

Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 61. Practical Work in Concrete Construction.

Preparation required: Cer. 12.

Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 62. Practical Work in Concrete Construction.

Preparation required: Cer. 61.

Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Cer. 63. Practical Work in Concrete Construction.

Preparation required: Cer. 62.

Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

- Cer. 64. Practical Work in Glass Making.
Preparation required: Cer. 9, 10.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Cer. 65. Practical Work in Glass Making.
Preparation required: Cer. 64.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Cer. 66. Practical Work in Glass Making.
Preparation required: Cer. 65.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Cer. 67. Research Work in Ceramics.
Preparation required: Cer. 26.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 68. Research Work in Ceramics.
Preparation required: Cer. 67.
Graduate Work, Second Semester, 2 to 20 credits.
- Cer. 69. Research Work in the Manufacture of Brick, Tile, Terra Cotta, etc.
Preparation required: Cer. 17, 18.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 70. Research Work in the Manufacture of Brick, Tile, Terra Cotta, etc.
Preparation required: Cer. 69.
Graduate Work, Second Semester, 2 to 20 credits.
- Cer. 71. Research Work in the Manufacture of Pottery and Porcelain.
Preparation required: Cer. 19, 20.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 72. Research Work in the Manufacture of Pottery and Porcelain.
Preparation required: Cer. 71.
Graduate Work, Second Semester, 2 to 20 credits.
- Cer. 73. Research Work in Cement Manufacture, Properties, and Uses.
Preparation required: Cer. 13, 14.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 74. Research Work in Cement Manufacture, Properties, and Uses.
Preparation required: Cer. 73.
Graduate Work, Second Semester, 2 to 20 credits.
- Cer. 75. Research Work in Concrete Manufacture, Properties, and Uses.
Preparation required: Cer. 16.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 76. Research Work in Concrete Manufacture, Properties, and Uses.
Preparation required: Cer. 75.
Graduate Work, Second Semester, 2 to 20 credits.

- Cer. 77. Research Work in Glass Making.
Preparation required: Cer. 37, 38.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 78. Research Work in Glass Making.
Preparation required: Cer. 77.
Graduate Work, Second Semester, 2 to 20 credits.
- Cer. 79. Research Work in Clay Working.
Preparation required: Cer. 1, 2, 12.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 80. Research Work in Clay Working.
Preparation required: Cer. 79.
Graduate Work, Second Semester, 2 to 20 credits.
- Cer. 81. Research Work in Clay Testing.
Preparation required: Cer. 1, 21.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 82. Research Work in Clay Testing.
Preparation required: Cer. 81.
Graduate Work, Second Semester, 2 to 20 credits.
- Cer. 83. Ceramic Education.
Preparation required: Cer. 20, 26, 48.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 84. Ceramic Education.
Preparation required: Cer. 83.
Graduate Work, Second Semester, 2 to 20 credits.
- Cer. 85. History of Ceramics.
Preparation required: Cer. 20, 26, 48.
Graduate Work, First Semester, 2 to 20 credits.
- Cer. 86. History of Ceramics.
Preparation required: Cer. 85.
Graduate Work, First Semester, 2 to 20 credits.

The term Ceramics is used here in its broadest sense to include not only brick, tile, terra cotta, pottery, and porcelain manufactures, but also limes, plasters, cements, concretes, glass making, etc.

The intention in the instruction in Ceramics is to train the student thoroughly in the principles or science of the subject, and then give him sufficient practical experience in the application of those principles so he can assimilate and understand them.

II. GEOLOGY

The subjects in Geology are especially adapted to the needs of the prospector, the explorer, the teacher, the engineer, the petrographer, the geologist, the miner, the quarryman, and all others who desire to understand the connection and the structural relations that rock-masses bear to one another, and to the valuable deposits that they contain. The

courses treat of the origin and alteration of the rocks, of volcanic and earthquake action, sedimentation, metamorphism, jointing, faulting, cleavage, mountain building, eruptive rocks, and crystalline schists; the action of air, surface and underground waters, and life, especially in their relations to the problems that the mining geologist, miner, and quarryman have to meet. The student has brought before him constantly the various problems that arise in practical work and the methods of their solution.

These subjects enlarge upon and complete much that is more briefly touched upon in Mineralogy and Petrography. The instruction is given by lectures and by recitations based upon the lectures and upon various text books.

Geol. 1. Principles of Physical Geography.

Freshman Year, First Semester, 2 credits.

Geol. 2. Physical Geography (Meteorology.)

Preparation required: Geol. 1.

Freshman Year, Second Semester, 2 credits.

Geol. 3. Advanced Physical Geography.

Preparation required: Geol. 2 or 5.

Sophomore Year, First Semester, 2 credits.

Geol. 4. Advanced Physical Geography.

Preparation required: Geol. 3 or 6.

Sophomore Year, Second Semester, 2 credits.

The work in Physical Geography will cover the general principles of the subject, especially earth sculpture, meteorology, and the action of the forces at work to modify the earth's surface and their effects upon the various industries.

Geol. 5. General Geology.

Taken with Min. 1.

Freshman Year, First Semester, 2 credits.

Under this head instruction is given by means of text-books and lectures on the general principles of geological science, including the probable origin and structure of the earth; volcanic and earthquake action; the destructive and reconstructive action of air and water, both surface and subterranean; the important earth-building minerals and rocks, their alterations and accidents; and the geological ages.

Geol. 6. Structural and Field Geology.

Preparation required: Min. 1; Geol. 5. Taken with Min. 2.

Freshman year, Second Semester, 2 credits.

This course is intended to cover the general principles of Geology in their applications in Physical, Chemical, Stratigraphical, Engineering, and Field Geology, and to supplement Geol. 5.

Geol. 7. Biological Geology.

Freshman Year, First Semester, 2 credits.

This subject will treat of the ancient life upon the globe, its characteristics, classification, and nomenclature. It is an elementary introduction to the work in Geol. 8.

Geol. 8. Stratigraphical Geology.

Preparation required: Geol. 5, 7.

Freshman Year, Second Semester, 2 credits.

Geol. 9. Physical and Chemical Geology.

Preparation required: Geol. 5, 6. Taken with Pet. 1.

Sophomore Year, First Semester, 2 credits.

Geol. 10. Physical and Chemical Geology.

Preparation required: Geol. 9. Taken with Pet. 2.

Sophomore Year, Second Semester, 2 credits.

Subjects 9 and 10 in Geology will treat of the structure of the earth's interior, the principles and evidences relating thereto, the applications of physical and chemical principles to the earth's development, and to its modifications. This work is especially intended to train the student for his subsequent work as an engineer, miner, prospector, and geologist.

Geol. 11. Azoic or Archæan Geology.

Preparation required: Geol. 5, 6, 9, 10; Pet. 3, 4. Taken with Pet. 5.

Senior Year, First Semester, 2 credits.

Geol. 12. Azoic or Archæan Geology.

Preparation required: Geol. 11. Taken with Pet. 6.

Senior Year, Second Semester, 2 credits.

In subjects 11 and 12 are taken up the history of the discussions relating to the Azoic or Archæan system, and the development of the views relating thereto. It will describe the rocks, their mode of formation, the various subdivisions of the system, and the evidences upon which they are based.

The instruction will be given by lectures and by the study of the literature.

Geol. 13. Paleozoic Geology.

Preparation required: Geol. 6, 8.

Sophomore Year, First Semester, 2 credits.

Geol. 14. Paleozoic Geology.

Preparation required: Geol. 13.

Sophomore Year, Second Semester, 2 credits.

Geol. 13 and 14 are intended to give the student a fair working knowledge of the Cambrian, Ordovician, Silurian, Mississippian, Pennsylvanian, and Permian periods. They will treat of the physical conditions and life of those periods. They should be taken in connection with the laboratory study of Paleontology.

Geol. 15. Mesozoic and Cenozoic Geology.

Preparation required: Geol. 14.

Junior Year, First Semester, 2 credits.

Geol. 16. Mesozoic and Cenozoic Geology.

Preparation required: Geol. 15.

Junior Year, Second Semester, 2 credits.

Geol. 15 and 16 are intended to give a fair working knowledge of the Triassic, Jurassic, Comanchean, Cretaceous, Eocene, Miocene, Pliocene, Pleistocene, and Recent Periods. They will treat of the life and physical conditions of those periods. They should be taken in connection with the laboratory study of Paleontology.

Geol. 17. Glacial Geology.

Preparation required: Geol. 5, 6, 8, 9, 10.

Junior Year, First Semester, 2 credits.

Geol. 18. Glacial Geology.

Preparation required: Geol. 17.

Junior Year, Second Semester, 2 credits.

Subjects 17 and 18 relate to the general phenomena of ancient and modern glaciation, with particular attention given to North America and Europe.

Geol. 19. Prehistoric Man.

Preparation required: Geol. 18.

Senior Year, First Semester, 2 credits.

Geol. 20. Prehistoric Man.

Preparation required: Geol. 19.

Senior Year, Second Semester, 2 credits.

Subjects 17 and 18 treat of the various evidences of the presence of man in the Pleistocene and Recent Periods, as well as the questions relating to his earlier appearance. Attention is further given to the correlated geology.

Geol. 21. Geology of the United States.

Preparation required: Geol. 5, 6, 8, 9, 10, 13, 14, 15, 16.

Senior Year, First Semester, 2 credits.

Geol. 22. Geology of the United States.

Preparation required: Geol. 21.

Senior Year, Second Semester, 2 credits.

In these subjects particular attention is given to the Paleontology and Stratigraphical Geology of the United States.

Geol. 23. Geology of Pennsylvania.

Preparation required: Geol. 22.

Graduate Work, First Semester, 2 credits.

Geol. 24. Geology of Pennsylvania.

Preparation required: Geol. 23.

Graduate Work, Second Semester, 2 to 20 credits.

Attention is given in Geol. 23 and 24 to the topography of the State, its various geological formations, their distribution and relation, and to their economic deposits and fossils.

Geol. 25. The Philosophy of Geology.

Preparation required: Geol. 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16; Pet. 1, 2, 3, 4, 5, 6.

Graduate Work, First Semester, 2 credits.

Geol. 26. The Philosophy of Geology.

Preparation required: Geol. 25.

Graduate Work, Second Semester, 2 credits.

Subjects 25 and 26 in Geology will take up the modes of thought employed in modern geological reasoning and discuss the soundness of the principles involved.

Geol. 27. History of Geology and Paleontology.

Preparation required: Geol. 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16; Pal. 8, 16, 24, 34; Pet. 1, 2, 3, 4, 5, 6.

Graduate Work, First Semester, 2 credits.

Geol. 28. History of Geology and Paleontology.

Preparation required: Geol. 27.

Graduate Work, Second Semester, 2 credits.

In subjects 27 and 28 will be traced the evolution of opinions in Geology, Petrography, and Paleontology in order that the student may obtain a clear understanding of the development of these sciences.

Geol. 29. Research Work in Physical Geography or Physiographic Geology.

Preparation required: Geol. 1, 2, 3, 4, 5, 6, 9, 10.

Graduate Work, First Semester, 2 to 20 credits.

Geol. 30. Research Work in Physical Geography or Physiographic Geology.

Preparation required: Geol. 51.

Graduate Work, Second Semester, 2 to 20 credits.

Geol. 31. Volcanoes and Earthquakes.

Preparation required: Geol. 5, 6, 9, 10; Pet. 1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14.

Graduate Work, First Semester, 2 to 20 credits.

Geol. 32. Volcanoes and Earthquakes.

Preparation required: Geol. 31.

Graduate work, Second Semester, 2 to 20 credits.

The courses will treat of volcanic and earthquake phenomena and such other phenomena as appear to be dependent upon the earth's heated interior. They are especially intended as an aid in the study of rocks, metamorphism, and ore deposits.

Geol. 33. Research Work in Physical Geology.

Preparation required: Geol. 9, 10, 11, 12; Pet. 5, 6, 13, 14.

Graduate Work, First Semester, 2 to 20 credits.

- Geol. 34. Research Work in Physical Geology.
Preparation required: Geol. 33.
Graduate Work, Second Semester, 2 to 20 credits.
- Geol. 35. Research Work in Azoic or Archaean Geology.
Preparation required: Geol. 9, 10, 11, 12; Pet. 5, 6, 13, 14.
Graduate Work, First Semester, 2 to 20 credits.
- Geol. 36. Research Work in Azoic or Archaean Geology.
Preparation required: Geol. 35.
Graduate Work, Second Semester, 2 to 20 credits.
- Geol. 37. Research Work in Stratigraphical or Historical Geology.
Preparation required: Geol. 8, 13, 14, 15, 16; Pal. 8, 16, 24, 34.
Graduate Work, First Semester, 2 to 20 credits.
- Geol. 38. Research Work in Stratigraphical or Historical Geology.
Preparation required: Geol. 37.
Graduate Work, Second Semester, 2 to 20 credits.
- Geol. 39. Research Work in Glacial Geology.
Preparation required: Geol. 3, 4, 5, 6, 9, 10, 13, 14, 15, 16, 17, 18.
Graduate Work, First Semester, 2 to 20 credits.
- Geol. 40. Research Work in Glacial Geology.
Preparation required: Geol. 39.
Graduate Work, Second Semester, 2 to 20 credits.
- Geol. 41. Prehistoric Man.
Preparation required: Geol. 5, 6, 7, 8, 9, 10, 14, 15, 16, 17, 18, 19, 20.
Graduate Work, First Semester, 2 to 20 credits.
- Geol. 42. Prehistoric Man.
Preparation required: Geol. 41.
Graduate Work, Second Semester, 2 to 20 credits.
- Geol. 43. Research Work in the Geology of the United States.
Preparation required: Geol. 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 21, 22;
Pal. 8, 16, 24, 34; Pet. 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- Geol. 44. Research Work in the Geology of the United States.
Preparation required: Geol. 43.
Graduate Work, Second Semester, 2 to 20 credits.
- Geol. 45. Research Work in Chemical Geology.
Preparation required: 187, 188; Geol. 9, 10.
Graduate Work, First Semester, 2 to 20 credits.
- Geol. 46. Research Work in Chemical Geology.
Preparation required: Geol. 45.
Graduate Work, Second Semester, 2 to 20 credits.
- Geol. 47. Field Geology and Geological Surveying and Mapping.
Taken with Geol. 5.
Freshman Year, First Semester, 2 credits.

Geol. 48. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 47. Taken with Geol. 6.
Freshman Year, Second Semester, 2 credits.

Geol. 49. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 48.
Sophomore Year, First Semester, 2 credits.

Geol. 50. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 49.
Sophomore Year, Second Semester, 2 credits.

In the subjects 47, 48, 49, 50 the student is taught to make observations, to use the instruments employed in geological surveying, to determine the rocks in the field, their relation, and to make geological maps and sections of the area studied.

Geol. 51. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 50.
Junior Year, First Semester, 2 credits.

Geol. 52. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 51.
Junior Year, Second Semester, 2 credits.

Geol. 53. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 52.
Senior Year, First Semester, 2 credits.

Geol. 54. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 53.
Senior Year, Second Semester, 2 credits.

Geol. 55. Field Geology and Geological Surveying and Mapping.
Taken with Geol. 47.
Freshman Year, First Semester, 1 to 12 credits.

Geol. 56. Field Geology and Geological Surveying and Mapping.
Taken with Geol. 48.
Freshman Year, Second Semester, 1 to 12 credits.

Geol. 57. Field Geology and Geological Surveying and Mapping.
Taken with Geol. 49.
Sophomore Year, First Semester, 1 to 12 credits.

Geol. 58. Field Geology and Geological Surveying and Mapping.
Taken with Geol. 50.
Sophomore Year, Second Semester, 1 to 12 credits.

Geol. 59. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 50.
Junior Year, First Semester, 1 to 12 credits.

Geol. 60. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 51.
Junior Year, Second Semester, 1 to 12 credits.

Geol. 61. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 52.
Senior Year, First Semester, 1 to 12 credits.

Geol. 62. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 53.
Senior Year, Second Semester, 1 to 12 credits.

Geol. 63. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 54.
Graduate Work, First Semester, 2 to 20 credits.

Geol. 64. Field Geology and Geological Surveying and Mapping.
Preparation required: Geol. 54 and 63.
Graduate Work, Second Semester, 2 to 20 credits.

The work in Field Geology and in the Geological Laboratory are intended to supplement the work in Geology and Mining. It is purposed to train the student in the practical methods of observation in the field and in making his own maps and sections in the laboratory. Excursions will be taken for the purpose of field study, particularly on Saturdays.

Geol. 65. Practical Work in Geology.
Preparation required: Geol. 48.
Freshman Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Geol. 66. Practical Work in Geology.
Preparation required: Geol. 50.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Geol. 67. Practical Work in Geology.
Preparation required: Geol. 52.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Geol. 68. Practical Work in Geology.
Preparation required: Geol. 54.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Geol. 69. Practical Work in Geology.
Preparation required: Geol. 64.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Geol. 70. Research Work in Geology.
Preparation required: Geol. 5, 6, 9, 10, 11, 12, or Geol. 5, 6, 8, 13, 14, 15, 16, 21, 22.
Graduate Work, First Semester, 2 to 20 credits.

Geol. 71. Research Work in Geology.
Preparation required: Geol. 70.
Graduate Work, Second Semester, 2 to 20 credits.

Geol. 72. Elementary Mineralogy and Petrography.
For Students of the College and Engineering School.
First Semester, Senior Year, 2 credits.

Geol. 73. Geological Education.
Preparation required: Geol. 9, 10, 11, 12, 13, 14, 15, 16, 47, 48, 65, 66.
Graduate Work, First Semester, 2 to 20 credits.

Geol. 74. Geological Education.

Preparation required: Geol. 73.

Graduate Work, Second Semester, 2 to 20 credits.

III. METALLURGY

Met. 1. The Principles of Metallurgy.

Preparation required: 185, 194; Min. 1, 2; Geol. 5, 6; M. Geol. 1, 2.

Taken with Ore. 1.

Sophomore Year, First Semester, 2 credits.

This is an elementary subject, giving the principles which underlie the general subject of Metallurgy. It deals briefly with fuels, fluxes, slags, furnaces, refractory materials, metallurgical processes, and aims to cover the entire field in preparation for the more detailed courses which are given later.

Met. 2. Fuels, Calorimetry, Pyrometry, etc.

Preparation required: 185, 186, 194.

Taken with Met. 1.

Sophomore Year, First Semester, 2 credits.

Met. 3. Fuels, Calorimetry, Pyrometry, etc.

Preparation required: Met. 2.

Sophomore Year, Second Semester, 2 credits.

Attention is paid to the preparation, properties, uses, and valuation of fuels, and the different forms of calorimeters, and the methods of determining the heating values of fuels are carefully studied. The measurement of high temperatures upon which the successful application of metallurgical principles rests is treated very fully.

Met. 4. Furnaces and Refractory Materials.

Preparation required: M. Geol. 1, 2. Taken with Met. 1.

Sophomore Year, First Semester, 2 credits.

Met. 5. Furnaces and Refractory Materials.

Preparation required: Met. 1, 2, 4; M. Geol. 1, 2. Taken with Met. 3.

Sophomore Year, Second Semester, 2 credits.

The manufacture, properties, uses, and testing of the various materials employed for furnace linings, crucibles and in other metallurgical operations, to withstand the action of heat and slags, such as fire clays, fire brick, ganister, chromite, magnesite, silica, and others. Also construction and use of furnaces.

Met. 6. Alloys, etc.

Preparation required: Met. 1, 13. Taken with Met. 14.

Sophomore Year, Second Semester, 2 credits.

This subject treats of the manufacture, properties, and uses of alloys, such as brasses, bronzes, fusible metals, solders, friction metals, etc.

Met. 7. Metallurgical Calculations.

Preparation required: 185, 186, 194. Taken with Met. 1.

Sophomore Year, First Semester, 2 credits.

Met. 8. Metallurgical Calculations.

Preparation required: Met. 7. Taken with Met. 3.
Sophomore Year, Second Semester, 2 credits.

Met. 9. Metallurgical Calculations.

Preparation required: Met. 8. Taken with Met. 15, or 19, or 28.
Junior Year, First Semester, 2 credits.

Met. 10. Metallurgical Calculations.

Preparation required: Met. 9. Taken with Met. 16, or 20, or 29, or 32.
Junior Year, Second Semester, 2 credits.

Met. 11. Metallurgical Calculations.

Preparation required: Met. 10. Taken with Met. 17, or 21, or 23, or 25, or 26, or 30, or 33.
Senior Year, First Semester, 2 credits.

Met. 12. Metallurgical Calculations.

Preparation required: Met. 11. Taken with Met. 18, or 22, or 24, or 27, or 31, or 34.
Senior Year, Second Semester, 2 credits.

The subject of Metallurgical Calculations deals with the solution of such problems as the metallurgist will be called upon to solve, and which involve the application of chemical and metallurgical knowledge.

Met. 13. Metallography—The Microscopic Study of Metals and Alloys.
Taken with Met. 1.

Sophomore Year, First Semester, 2 credits.

Met. 14. Metallography—The Microscopic Study of Metals and Alloys.
Preparation required: Met. 1, 13.

Sophomore Year, Second Semester, 2 credits.

Metallography deals with the theories of heat treatment of metals and alloys, and with the methods of making the structure visible. It also considers the influence of changes of structure in the properties of the metals or alloys.

Met. 15. Metallurgy of Iron, Foundry Work, etc.

Preparation required: 187; Met. 1, 2, 3, 4, 5, 13, 14; Ore. 1.
Junior Year, First Semester, 2 credits.

Met. 16. Metallurgy of Iron, Foundry Work, etc.

Preparation required: Met. 15.
Junior Year, Second Semester, 2 credits.

The subjects relating to the Metallurgy of Iron deal in detail with all the phases of furnace practice and foundry work. Some of the topics considered are as follows: The furnace burden, ore mixing, the calculation of furnace burdens, the operation of the blast furnace, the chemistry of the production of pig iron, the use of the dry air blast, the properties of pig iron, the grading of pig iron, the testing of pig iron, the foundry, methods of remelting, cupolas, charging cupolas, air fur-

naces, crucibles, making castings, properties of cast iron, effects of methods of remelting on the composition and properties of cast iron, testing cast iron for foundry uses, malleable cast iron, wrought iron, etc.

Met. 17. The Metallurgy of Steel.

Preparation required: Met. 16.

Senior Year, First Semester, 3 credits.

Met. 18. The Metallurgy of Steel.

Preparation required: Met. 17.

Senior Year, Second Semester, 2 credits.

The subjects in the Metallurgy of Steel comprise a study of: (1) The Bessemer process, the chemistry of the acid and basic Bessemer processes, the theory and construction of gas producers, the open-hearth or Siemens process, acid and basic, and the production of steel castings; (2) the mechanical treatment of steel, including a study of the five leading types of rolling mills and the four processes for the manufacture of steel tubes; (3) the heat treatment of steel. Visits of inspection are made to a number of the very excellent steel and tube mills in the vicinity of Pittsburgh.

Met. 19. Metallurgy of Gold and Silver.

Preparation required: 187; Met. 1, 2, 3, 4, 5; Ore. 1.

Junior Year, First Semester, 2 credits.

Met. 20. Metallurgy of Gold and Silver.

Preparation required: Met. 19.

Junior Year, First Semester, 2 credits.

Met. 21. Metallurgy of Copper.

Preparation required: 187; Met. 1, 2, 3, 4, 5; Ore. 1.

Senior Year, First Semester, 2 credits.

Met. 22. Metallurgy of Copper.

Preparation required: Met. 21.

Senior Year, Second Semester, 2 credits.

The subjects in the Metallurgy of Copper cover the production and properties of copper, including roasting of the ores, the blast furnace matting processes, the reverberatory matting processes, pyritic smelting, Bessemerizing mattes, reverberatory processes for obtaining copper, the refining of copper, electrolytic refining, etc.

Met. 23. Metallurgy of Lead.

Preparation required: 187; Met. 1, 2, 3, 4, 5; Ore. 1.

Senior Year, First Semester, 2 credits.

Met. 24. Metallurgy of Lead.

Preparation required: Met. 23.

Senior Year, Second Semester, 2 credits.

The subjects in the Metallurgy of Lead cover the preparation and properties of lead, including the roasting of the ores, the blast furnace

processes, the hearth processes, the reverberatory processes, the methods of extracting silver and gold, and the refining of lead.

Met. 25. The Metallurgy of Zinc.

Preparation required: 187; Met. 1, 2, 3, 4, 5; Ore. 1.
Senior Year, First Semester, 2 credits.

Met. 26. The Metallurgy of the Minor Metals.

Preparation required: 187; Met. 1, 2, 3, 4, 5; Ore. 1.
Senior Year, First Semester, 2 credits.

Met. 27. The Metallurgy of the Minor Metals.

Preparation required: 187; Met. 1, 2, 3, 4, 5, 26.
Senior Year, Second Semester, 2 credits.

Subjects 26 and 27 treat of the production and properties of the less important metals, such as zinc, tin, antimony, nickel, chromium, manganese, etc.

Met. 28. Hydro-Metallurgy.

Preparation required: 187; Met. 1, 2, 3, 4, 5; Ore. 1.
Taken with Met. 19.

Junior Year, First Semester, 2 credits.

Met. 29. Hydro-Metallurgy.

Preparation required: Met. 28. Taken with Met. 20.
Junior Year, Second Semester, 2 credits.

Met. 30. Hydro-Metallurgy.

Preparation required: Met. 29.
Senior Year, First Semester, 2 credits.

Met. 31. Hydro-Metallurgy.

Preparation required: Met. 30.
Senior Year, Second Semester, 2 credits.

The subjects in Hydro-Metallurgy include experiments with wet processes of extracting metals from their ores, and tests to determine the availability of such wet processes for particular ores.

Met. 32. Electro-Metallurgical Processes.

Preparation required: 187; Met. 1, 2, 3, 4, 5; Ore. 1.
Junior Year, First Semester, 2 credits.

Met. 33. Electro-Metallurgical Processes.

Preparation required: Met. 32.
Junior Year, Second Semester, 2 credits.

Met. 34. Electro-Metallurgical Processes.

Preparation required: Met. 33. Taken with Met. 21.
Senior Year, First Semester, 2 credits.

Met. 35. Electro-Metallurgical Processes.

Preparation required: Met. 34. Taken with Met. 22.
Senior Year, Second Semester, 2 credits.

The subjects in the Electro-Metallurgical Processes treat of those metallurgical processes in which electricity plays a part, such as the

electric furnace methods of producing iron and steel, aluminum, ferro-alloys, electrolytic methods of refining of copper, lead, gold, and silver.

Met. 36. Metallurgical Designing.

Preparation required: 370, 371; Met. 1, 4, 5. Taken with Met. 15, or 19, or 28, or 32.

Junior Year, First Semester, 1 to 12 credits.

Met. 37. Metallurgical Designing.

Preparation required: Met. 36. Taken with Met. 16, or 20, or 29, or 33. Junior Year, Second Semester, 1 to 12 credits.

Met. 38. Metallurgical Designing.

Preparation required: Met. 37. Taken with Met. 17, or 21, or 23, or 25, or 26, or 30, or 34.

Senior Year, First Semester, 1 to 12 credits.

Met. 39. Metallurgical Designing.

Preparation required: Met. 38. Taken with Met. 18, or 22, or 24, or 27, or 31, or 35.

Senior Year, Second Semester, 1 to 12 credits.

Metallurgical Designing covers the designing of furnaces, smelting plants, ore dressing machinery, ore dressing plants, and other metallurgical or ore dressing apparatus.

Met. 40. Metallurgical Laboratory.

Taken with Met. 1, or 2, or 4.

Sophomore Year, First Semester, 2 credits.

Met. 41. Metallurgical Laboratory.

Preparation required: Met. 1, 40. Taken with Met. 3, or 5, or 6.

Sophomore Year, Second Semester, 2 credits.

Met. 42. Metallurgical Laboratory.

Preparation required: Met. 40, 41. Taken with Met. 15 or 19.

Junior Year, First Semester, 2 credits.

Met. 43. Metallurgical Laboratory.

Preparation required: Met. 42. Taken with Met. 16 or 20.

Junior Year, Second Semester, 2 credits.

Met. 44. Metallurgical Laboratory.

Preparation required: Met. 40, 41. Taken with Met. 17, or 21, or 23, or 25, or 26.

Senior Year, First Semester, 2 credits.

Met. 45. Metallurgical Laboratory.

Preparation required: Met. 44. Taken with Met. 18, or 22, or 24, or 27.

Senior Year, Second Semester, 2 credits.

Met. 46. Metallurgical Laboratory.

Taken with Met. 40.

Sophomore Year, First Semester, 1 to 12 credits.

Met. 47. Metallurgical Laboratory.

Taken with Met. 41.

Sophomore Year, Second Semester, 1 to 12 credits.

Met. 48. Metallurgical Laboratory.

Taken with Met. 42.

Junior Year, First Semester, 1 to 12 credits.

Met. 49. Metallurgical Laboratory.

Taken with Met. 43.

Junior Year, Second Semester, 1 to 12 credits.

Met. 50. Metallurgical Laboratory.

Taken with Met. 44.

Senior Year, First Semester, 1 to 12 credits.

Met. 51. Metallurgical Laboratory.

Taken with Met. 45.

Senior Year, Second Semester, 1 to 12 credits.

Met. 52. Hydro-Metallurgical Laboratory.

Preparation required: 187, 210; Met. 40, 41. Taken with Met. 28.

Junior Year, First Semester, 2 credits.

Met. 53. Hydro-Metallurgical Laboratory.

Preparation required: Met. 52. Taken with Met. 29.

Junior Year, Second Semester, 2 credits.

Met. 54. Hydro-Metallurgical Laboratory.

Preparation required: Met. 53. Taken with Met. 30.

Senior Year, First Semester, 2 credits.

Met. 55. Hydro-Metallurgical Laboratory.

Preparation required: Met. 54. Taken with Met. 31.

Senior Year, Second Semester, 2 credits.

Met. 56. Hydro-Metallurgical Laboratory.

Taken with Met. 52.

Junior Year, First Semester, 1 to 12 credits.

Met. 57. Hydro-Metallurgical Laboratory.

Taken with Met. 53.

Junior Year, Second Semester, 1 to 12 credits.

Met. 58. Hydro-Metallurgical Laboratory.

Taken with Met. 54.

Senior Year, First Semester, 1 to 12 credits.

Met. 59. Hydro-Metallurgical Laboratory.

Taken with Met. 55.

Senior Year, Second Semester, 1 to 12 credits.

Met. 60. Electro-Metallurgical Laboratory.

Preparation required: 187, 210; Met. 40, 41. Taken with Met. 32.

Junior Year, First Semester, 2 credits.

- Met. 61. Electro-Metallurgical Laboratory.
Preparation required: Met. 60. Taken with Met. 33.
Junior Year, Second Semester, 2 credits.
- Met. 62. Electro-Metallurgical Laboratory.
Preparation required: Met. 61. Taken with Met. 34.
Senior Year, First Semester, 2 credits.
- Met. 63. Electro-Metallurgical Laboratory.
Preparation required: Met. 62. Taken with Met. 35.
Senior Year, Second Semester, 2 credits.
- Met. 64. Electro-Metallurgical Laboratory.
Taken with Met. 60.
Junior Year, First Semester, 1 to 12 credits.
- Met. 65. Electro-Metallurgical Laboratory.
Taken with Met. 61.
Junior Year, Second Semester, 1 to 12 credits.
- Met. 66. Electro-Metallurgical Laboratory.
Taken with Met. 62.
Senior Year, First Semester, 1 to 12 credits.
- Met. 67. Electro-Metallurgical Laboratory.
Taken with Met. 63.
Senior Year, Second Semester, 1 to 12 credits.
- Met. 68. Fire Assaying.
Preparation required: 185, 186, 194; Min. 1, 2; M. Geol. 1, 2. Taken with 187.
Sophomore Year, First Semester, 2 credits.
- Met. 69. Fire Assaying.
Preparation required: Met. 68. Taken with 187.
Sophomore Year, Second Semester, 2 credits.
- Met. 70. Fire Assaying.
Preparation required: Met. 69. Taken with 188.
Junior Year, First Semester, 2 credits.
- Met. 71. Fire Assaying.
Preparation required: Met. 70.
Junior Year, Second Semester, 2 credits.
- Met. 72. Fire Assaying.
Preparation required: Met. 71.
Senior Year, First Semester, 2 credits.
- Met. 73. Fire Assaying.
Preparation required: Met. 72.
Senior Year, Second Semester, 2 credits.

The subjects in Fire Assaying cover the fire assay of lead, copper, gold, and silver ores. Each subject consists of six hours per week of

practical work in the assay laboratory, with occasional lectures and recitations on the theory and methods of fire assaying.

The aim of the work is to afford a thorough training in the theory and practice of assaying lead, copper, gold, and silver ores, according to the methods used in practical assay offices, and to so train the student that he may be able to take up and carry on this class of work after graduation.

Met. 74. Wet Assaying.

Preparation required: 185, 186, 194; Min, 1, 2. Taken with 187, Met. 1.
Sophomore Year, First Semester, 2 credits.

Met. 75. Wet Assaying.

Preparation required: Met. 74. Taken with 187.
Sophomore Year, Second Semester, 2 credits.

Met. 76. Wet Assaying.

Preparation required: Met. 75. Taken with 188.
Junior Year, First Semester, 2 credits.

Met. 77. Wet Assaying.

Preparation required: Met. 76. Taken with 188.
Junior Year, Second Semester, 2 credits.

Met. 78. Wet Assaying.

Preparation required: Met. 77.
Senior Year, First Semester, 2 credits.

Met. 79. Wet Assaying.

Preparation required: Met. 78.
Senior Year, Second Semester, 2 credits.

Met. 80. Wet Assaying.

Preparation required: Met. 79.
Graduate Work, First Semester, 2 to 20 credits.

Met. 81. Wet Assaying.

Preparation required: Met. 80.
Graduate Work, Second Semester, 2 to 20 credits.

Met. 82. Assaying Laboratory.

Taken with Met. 68 or 74.
Sophomore Year, First Semester, 1 to 12 credits.

Met. 83. Assaying Laboratory.

Taken with Met. 69 or 75.
Sophomore Year, Second Semester, 1 to 12 credits.

Met. 84. Assaying Laboratory.

Taken with Met. 70 or 76.
Junior Year, First Semester, 1 to 12 credits.

Met. 85. Assaying Laboratory.

Taken with Met. 71 or 77.
Junior Year, Second Semester, 1 to 12 credits.

Met. 86. Assaying Laboratory.

Taken with Met. 72 or 73.

Senior Year, First Semester, 1 to 12 credits.

Met. 87. Assaying Laboratory.

Taken with Met. 73 or 79.

Senior Year, Second Semester, 1 to 12 credits.

Met. 88. Practical Work in Metallurgy.

Preparation required: 185, 186, 194; Min. 1, 2.

Freshman Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 89. Practical Work in Metallurgy.

Preparation required: Met. 1, 2, 3, 4, 5.

Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 90. Practical Work in Metallurgy.

Preparation required: Met. 89.

Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 91. Practical Work in Metallurgy.

Preparation required: Met. 90.

Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 92. Practical Work in Metallurgy.

Preparation required: Met. 91.

Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 93. Practical Work in Assaying.

Preparation required: Met. 68 or 74.

Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 94. Practical Work in Assaying.

Preparation required: Met. 93.

Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 95. Practical Work in Assaying.

Preparation required: Met. 94.

Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 96. Practical Work in Assaying.

Preparation required: Met. 95.

Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 97. Practical Work in Hydro-Metallurgy.

Preparation required: Met. 28, 29.

Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 98. Practical Work in Hydro-Metallurgy.

Preparation required: Met. 97.

Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Met. 99. Practical Work in Hydro-Metallurgy.

Preparation required: Met. 98.

Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

- Met. 100. Practical Work in Electro-Metallurgy.
Preparation required: Met. 32, 33.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Met. 101. Practical Work in Electro-Metallurgy.
Preparation required: Met. 100.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Met. 102. Practical Work in Electro-Metallurgy.
Preparation required: Met. 101.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Met. 103. Research Work in Metallurgy.
Preparation required: Met. 18, or 20, or 22, or 24, or 25, or 27.
Graduate Work, First Semester, 2 to 20 credits.
- Met. 104. Research Work in Metallurgy.
Preparation required: Met. 103.
Graduate Work, Second Semester, 2 to 20 credits.
- Met. 105. Research Work in Assaying.
Preparation required: Met. 69, 75.
Graduate Work, First Semester, 2 to 20 credits.
- Met. 106. Research Work in Assaying.
Preparation required: Met. 105.
Graduate Work, Second Semester, 2 to 20 credits.
- Met. 107. Research Work in Hydro-Metallurgy.
Preparation required: Met. 31.
Graduate Work, First Semester, 2 to 20 credits.
- Met. 108. Research Work in Hydro-Metallurgy.
Preparation required: Met. 107.
Graduate Work, Second Semester, 2 to 20 credits.
- Met. 109. Research Work in Electro-Metallurgy.
Preparation required: Met. 35.
Graduate Work, First Semester, 2 to 20 credits.
- Met. 110. Research Work in Electro-Metallurgy.
Preparation required: Met. 109.
Graduate Work, Second Semester, 2 to 20 credits.
- Met. 111. Metallurgical Education.
Preparation required: Met. 1, 2, 3, 4, 5, 6, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 30, 31, 34, 35, 38, 39, 44, 45, 68, 69, 74, 75, 88, 89.
Graduate Work First Semester 2 to 20 credits.
- Met. 112. Metallurgical Education.
Preparation required: Met. 111.
Graduate Work, Second Semester, 2 to 20 credits.
- Met. 113. History of Metallurgy.
Preparation required: Met. 1, 2, 3, 4, 5, 6, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 30, 31, 34, 35, 38, 39, 44, 45, 68, 69, 74, 75, 88, 89.
Graduate Work First Semester 2 to 20 credits.

Met. 114. History of Metallurgy.

Preparation required: Met. 113.

Graduate Work, Second Semester, 2 to 20 credits.

Met. 115. Coke—Its Manufacture, Properties and Uses.

Preparation required: Met. 2, 3, 4, 5.

Junior Year, First Semester, 2 credits.

Met. 116. Coke—Its Manufacture, Properties and Uses.

Preparation required: Met. 115.

Junior Year, Second Semester, 2 credits.

IV. MINERALOGY.

In these subjects it is intended to take up the general principles of Crystallography, Mineralogy, and Macroscopical Petrography, with the corresponding laboratory work.

Min. 1. Crystallography and Mineralogy.

Taken with 185, 194..

Freshman Year, First Semester, 6 credits.

Min. 2. Mineralogy and Petrography.

Preparation required: Min. 1.

Freshman Year, Second Semester, 6 credits.

Min. 3. Mineralogy and Petrography.

Preparation required: Min. 2.

Sophomore Year, First Semester, 2 credits.

Min. 4. Mineralogy and Petrography.

Preparation required: Min. 3.

Sophomore Year, Second Semester, 2 credits.

Min. 5. Mineralogy and Petrography.

Preparation required: Min. 4.

Junior Year, First Semester, 2 credits.

Min. 6. Mineralogy and Petrography.

Preparation required: Min. 5.

Junior Year, Second Semester, 2 credits.

Min. 7. Mineralogy and Petrography.

Preparation required: Min. 6.

Senior Year, First Semester, 2 credits.

Min. 8. Mineralogy and Petrography.

Preparation required: Min. 7.

Senior Year, Second Semester, 2 credits.

Min. 9. Mineralogy and Petrography.

Taken with Min. 1.

Freshman Year, First Semester, 1 to 12 credits.

Min. 10. Mineralogy and Petrography.

Preparation required: Min. 1. Taken with Min. 2.
Freshman Year, Second Semester, 1 to 12 credits.

Min. 11. Mineralogy and Petrography.

Preparation required: Min. 2. Taken with Min. 3.
Sophomore Year, First Semester, 1 to 12 credits.

Min. 12. Mineralogy and Petrography.

Preparation required: Min. 3. Taken with Min. 4.
Sophomore Year, Second Semester, 1 to 12 credits.

Min. 13. Mineralogy and Petrography.

Preparation required: Min. 4. Taken with Min. 5.
Junior Year, First Semester, 1 to 12 credits.

Min. 14. Mineralogy and Petrography.

Preparation required: Min. 5. Taken with Min. 6.
Junior Year, Second Semester, 1 to 12 credits.

Min. 15. Mineralogy and Petrography.

Preparation required: Min. 6. Taken with Min. 7.
Senior Year, First Semester, 1 to 12 credits.

Min. 16. Mineralogy and Petrography.

Preparation required: Min. 7. Taken with Min. 8.
Senior Year, Second Semester, 1 to 12 credits.

Min. 17. Mathematical Crystallography.

Preparation required: 166, 169, 174; Min. 1, 2. Taken with Pet. 1.
Sophomore Year, Second Semester, 2 to 12 credits.

Min. 18. Mathematical Crystallography.

Preparation required: Min. 17. Taken with Pet. 2.
Sophomore Year, Second Semester, 2 to 12 credits.

In Min. 17 and 18 is taken up the applications of Mathematics in calculating the axial ratios, and the other constants in crystals, also the methods of projecting and drawing crystals. It is proposed in these subjects to give a full and complete course in Mathematical Crystallography and crystal projection. The associated practice is taken in the Crystallographic Laboratory.

Min. 19. Physical Mineralogy.

Preparation required: 185, 186, 194; Min. 1, 2, 17, 18; Pet. 1, 2.
Taken with Pet. 3.
Junior Year, First Semester, 2 to 12 credits.

Min. 20. Physical Mineralogy.

Preparation required: Min. 19. Taken with Pet. 4.
Junior Year, Second Semester, 2 to 12 credits.

Min. 21. Physical Mineralogy.

Preparation required: Min. 20. Taken with Pet. 5.
Senior Year, First Semester, 2 to 12 credits.

Min. 22. Physical Mineralogy.

Preparation required: Min. 21. Taken with Pet. 6.
Senior Year, Second Semester, 2 to 12 credits.

Subjects Min. 19 to 22 are arranged for the purpose of imparting to the student a good knowledge of the various physical properties of minerals, including their optical characteristics and their alterations.

Min. 23. Mineralogy of the United States.

Preparation required: Min. 22, 41.
Graduate Work, First Semester, 2 to 20 credits.

Min. 24. Mineralogy of the United States.

Preparation required: Min. 23.
Graduate Work, Second Semester, 2 to 20 credits.

Min. 25. Mineralogy of Pennsylvania.

Preparation required: Min. 22, 41.
Graduate Work, First Semester, 2 to 20 credits.

Min. 26. Mineralogy of Pennsylvania.

Preparation required: Min. 24.
Graduate Work, Second Semester, 2 to 20 credits.

Min. 27. Practical Work in Mineralogy.

Preparation required: Min. 1, 2.
Freshman Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Min. 28. Practical Work in Mineralogy.

Preparation required: Min. 1, 2.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Min. 29. Practical Work in Mineralogy.

Preparation required: Min. 1, 2.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Min. 30. Practical Work in Mineralogy.

Preparation required: Min. 1, 2.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Min. 31. Practical Work in Mineralogy.

Preparation required: Min. 1, 2.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Min. 32. Research Work in Crystallography.

Preparation required: Min. 17, 18.
Graduate Work, First Semester, 2 to 20 credits.

Min. 33. Research Work in Crystallography.

Preparation required: Min. 32.
Graduate Work, Second Semester, 2 to 20 credits.

Min. 34. Research Work in Determinative Mineralogy.

Preparation required: Min. 21, 22, 40, 41.
Graduate Work, First Semester, 2 to 20 credits.

Min. 35. Research Work in Mineralogy.

Preparation required: Min. 34.

Graduate Work, Second Semester, 2 to 20 credits.

Min. 36. Blowpipe Analysis.

Taken with 185 and Min. 1.

Freshman Year, First Semester, 1 or 2 credits.

Min. 37. Blowpipe Analysis.

Preparation required: Min. 1 and 35.

Taken with 186 and Min. 2.

Freshman Year, Second Semester, 1 or 2 credits.

Min. 38. Chemical Mineralogy.

Preparation required: 187, Min. 1, 2, 17, 18. Taken with 188.

Junior Year, First Semester, 2 to 12 credits.

Min. 39. Chemical Mineralogy.

Preparation required: Min. 38. Taken with 188.

Junior Year, Second Semester, 2 to 12 credits.

Min. 40. Chemical Mineralogy.

Preparation required: Min. 39.

Senior Year, First Semester, 2 to 12, credits.

Min. 41. Chemical Mineralogy.

Preparation required: Min. 40.

Senior Year, Second Semester, 2 to 12 credits.

Min. 42. Research Work in Physical Mineralogy.

Preparation required: Min. 17, 18, 19, 20, 21, 22.

Graduate Work, First Semester, 2 to 20 credits.

Min. 43. Research Work in Physical Mineralogy.

Preparation required: Min. 42.

Graduate Work, Second Semester, 2 to 20 credits.

Min. 44. Research Work in Chemical Mineralogy.

Preparation required: 185, 186, 187, 188; Min. 1, 2, 38, 39, 40, 41.

Graduate Work, First Semester, 2 to 20 credits.

Min. 45. Research Work in Chemical Mineralogy.

Preparation required: Min. 44.

Graduate Work, First Semester, 2 to 20 credits.

Min. 46. Mineralogical Education.

Preparation required: Min. 1, 2, 17, 18, 19, 20, 21, 22, 27, 28, 38, 39, 40, 41.

Graduate Work, First Semester, 2 to 20 credits.

Min. 47. Mineralogical Education.

Preparation required: Min. 46.

Graduate Work, Second Semester, 2 to 20 credits.

Min. 48. History of Crystallography and Mineralogy.

Preparation required: Min. 1, 2, 17, 18, 19, 20, 21, 22, 27, 28, 38, 39, 40, 41.

Graduate Work, First Semester, 2 to 20 credits.

Min. 49. History of Crystallography and Mineralogy.

Preparation required: Min. 48.

Graduate Work, Second Semester, 2 to 20 credits.

The instruction in Mineralogy is divided into five parts: Crystallography, Determinative Mineralogy, Physical Mineralogy, Chemical Mineralogy and Macroscopical Petrography. These are all taken as consecutive and closely co-ordinated subjects that are essential to a proper comprehension of the subjects of geology and mining.

CRYSTALLOGRAPHY.—The instruction given is by means of a text-book on *Crystallography*, Wadsworth, with lectures and laboratory practice in determining the crystal forms of models and natural crystals.

As the student's future work in Mineralogy depends largely upon his knowledge of Crystallography, he is required to familiarize himself with the principles which it involves, and to become sufficiently expert in determining forms to be able to apply it practically in the Determinative Mineralogy.

This work is supplemented in the Sophomore Year by Mathematical Crystallography, with the use of the goniometer and practice in the drawing of crystals.

DETERMINATIVE MINERALOGY.—For Determinative Mineralogy there is provided a typical set of important minerals, special attention being paid to those of economic value, as well as to those occurring as gangue or rock-forming minerals. Special collections are arranged, showing the physical characters of minerals.

Besides the typical lecture collections of minerals, there are placed in other drawers specimens of the same mineral species. They are arranged in convenient groups, but are unlabeled. These specimens are selected so as to represent as great a variety of forms, appearance, and locality as possible, in order that the student may be made familiar with all the types that he will be likely to meet in his professional practice. Drawers containing the unlabeled minerals are assigned to each student, who is to determine them and recite upon them, not in a class, but singly with the instructor. He is required to do that which the practical mineralogist does: to determine his minerals by the shortest methods possible consistent with accuracy; the method to vary according to the specimen. To this end every method of determination short of quantitative analysis is employed; that is, in each case the crystal form and other physical characters are used, as well as the blowpipe and wet tests, so far as they may be needed.

After the student has studied and recited upon the specimens contained in a sufficient number of drawers of one group, he is assigned drawers containing the unlabeled minerals of another group, which have mixed with them specimens of the preceding group or groups. In this way each student is required to determine in his course from one thousand to three thousand different mineral specimens belonging to the selected species.

As a basis for the Determinative Mineralogy, Dr. Edward S. Dana's *Text-Book of Mineralogy* is used, supplemented by *Practical Mineralogy*, Wadsworth. In the latter the characteristic features of each mineral, its uses, and the practical methods employed to distinguish each one are pointed out. Especial attention is given to the methods needed in the field and mine, where one cannot have recourse to a chemical laboratory. Every effort is made to train the student to close, accurate observation, to reason correctly upon what he sees, and to exercise good judgment in his decision.

The result of this work is such that a student not only knows how to proceed in order to determine any mineral that he may meet, but he is also enabled to recognize at sight, or by simple tests, the great majority of specimens belonging to the important mineral species selected.

PHYSICAL MINERALOGY—In this subject are taken up the general physical properties of minerals; the use of the polariscope, etc.; and the study of their alterations.

CHEMICAL MINERALOGY—Under this heading are considered the methods of analyzing minerals and rocks; their chemical constitution; their chemical classification; etc.

MACROSCOPICAL PETROGRAPHY.—In this subject the student is taught to determine by means of the eye, the lens, and a few simple tests how to recognize the principal rocks of the globe. For this work collections of rock specimens are arranged for the use of the student. The course of instruction is similar to that followed in the course of Mineralogy. Lectures are given upon the specimens of the typical collections, the method of classification is explained, and the distinguishing characters of the different groups, species, and varieties are pointed out. Particular attention is called to the variations and alterations in rocks and to their local modifications due to their special mode of occurrence in the field.

The object of the course is to give the student such training in the practical determination of rocks as will enable him to know them in the field and mine, as well as to observe their alterations and modifications—subjects that have very important bearings upon the vital questions relating to ore deposits.

After the study of a sufficiently large number of types has been made the student has assigned to him a large number of drawers containing unlabeled specimens of these rocks, which he is expected to determine and recite upon, as he has done in his study of minerals. The course is thus made thorough and practical, and is adapted to the needs of the miner, the teacher, and the geologist, giving them a training which they can make use of in their future work.

V. MINING

Mine. 1. Mining—Boring, Drilling, Sinking, Supporting or Timbering, Exploitation, Hydraulic Mining, Dredging, etc.
Preparation required: 169, 185, 194; Min. 1, 2; Geol. 5, 6; M. Geol. 1, 2.
Sophomore Year, First Semester, 2 credits.

Mine. 2. Mining—Explosives, Power Transmission, Haulage, Hoisting, Drainage, Ventilation, Lighting, etc.
Preparation required: Mine. 1.
Sophomore Year, Second Semester, 2 credits.

Mine. 1 and 2 are intended to give a general resume of the elementary principles of mining, such as every student of this School should understand. It is also to serve as a basis for the subsequent studies of those students who intend to devote their future life to mining work.

Mine. 3. Mine Calculations and Estimates.
Preparation required: 169, 172. Taken with Mine 1.
Sophomore Year, First Semester, 2 credits.

Mine. 4. Mine Calculations and Estimates.
Preparation required: Mine. 3. Taken with Mine. 2.
Sophomore Year, Second Semester, 2 credits.

Mine. 5. Coal Mining.
Preparation required: 169, 172; Mine. 1, 2, 44, 45; M. Geol. 1, 2.
Junior Year, First Semester, 2 credits.

Mine. 6. Coal Mining.
Preparation required: Mine. 5.
Junior Year, Second Semester, 2 credits.

Mine. 5 and 6 are intended to cover the general principles of the methods of mining anthracite and bituminous coals, as practiced in this State and abroad. Owing to the location of the School, it is enabled to give the student exceptional advantages in learning the actual practice in bituminous mines. Visits of inspection to many of the important mines in the vicinity are taken from time to time.

Mine. 7. Metal Mining.
Preparation required: Mine. 1, 2, 44, 45; M. Geol. 5, 6.
Junior Year, First Semester, 2 credits.

Mine. 8. Metal Mining.

Preparation required: Mine. 7.

Junior Year, Second Semester, 2 credits.

Courses 7 and 8 are devoted to the study of Ore and Stone Mining, in order to prepare the student for the special conditions he will meet in work of that character.

Mine. 9. Mining Engineering.

Preparation required: 166, 169, 172, 174, 175, 176; Mine. 1, 2, 44, 45.

Taken with 285; Mine. 5 or 7.

Junior Year, First Semester, 2 credits.

Mine. 10. Mining Engineering.

Preparation required: Mine 9. Taken with 286, 289; Mine 6 or 8.

Junior Year, Second Semester, 2 credits.

Mine. 11. Mining Engineering.

Preparation required: Mine. 10. Taken with 291.

Senior Year, First Semester, 2 credits.

Mine. 12. Mining Engineering.

Preparation required: Mine. 11. Taken with 292.

Senior Year, Second Semester. 2 credits.

In subjects 9, 10, 11 and 12 are considered the questions in Mining that confront the engineer, and require from him the application of Higher Mathematics, Mechanics, Physics, and Chemistry.

Mine. 13. Mine Gases, Ventilation, Lighting, etc.

Preparation required: 169; Mine. 1, 2, 44, 45. Taken with Mine. 5.

Junior Year, First Semester, 2 credits.

Mine. 14. Mine Gases, Ventilation, Lighting, etc.

Preparation required: Mine. 13. Taken with Mine. 6.

Junior Year, Second Semester, 2 credits.

In subjects 13 and 14 especial attention is paid to problems associated with the underground workings of mines; the best methods of ventilating and lighting them; the detection and care of mine gases, etc. This work is especially intended to cover the usual duties of fire bosses and foremen, and to give the knowledge that every superintendent and manager should have.

Mine. 15. "Laying Out" of Mines and their Surface and Underground Plants.

Preparation required: M. Sur. 1, 2; Mine. 44, 45, and 5, 6 or 7, 8.

Senior Year, First Semester, 2 credits.

Mine. 16. "Laying Out" of Mines and their Surface and Underground Plants.

Preparation required: Mine. 15.

Senior Year, Second Semester, 2 credits.

In subjects 15 and 16 particular attention is given to the surface and underground arrangements of mines and their plants. Visits of

inspection are made to various mines in the vicinity and their arrangements and plants studied.

Mine. 17. Mine Management, Accounts, Supplies, Purchases, Sales, etc., or Mine Office Work.

Preparation required: Mine. 1, 2; Ore. 1; Met. 1, 68.

Junior Year, First Semester, 2 credits.

Mine. 18. Mine Management, Accounts, Supplies, Purchases, Sales, etc., or Mine Office Work.

Preparation required: Mine. 17.

Junior Year, Second Semester, 2 credits.

Subjects 17 and 18 are intended to give the student a general insight into the work of Mining, Metallurgical, Assaying or other offices, the methods of bookkeeping employed, keeping record of the stock, procuring supplies, selling the product, etc. Upon the knowledge and skill shown in the above work often depends the success or failure of the venture, and every student should be well trained along these lines, no matter what branch of mineral industry he intends to follow.

Mine. 19. Mining and Ventilating Machinery.

Preparation required: Mine. 1, 2, 44, 45. Taken with Mine. 13.

Junior Year, First Semester, 2 credits.

Mine. 20. Mining and Ventilating Machinery.

Preparation required: Mine. 19. Taken with Mine. 14.

Junior Year, Second Semester, 2 credits.

Mine. 21. Power Generation and Transmission in Mines.

Preparation required: Mine. 1, 2, 44, 45.

Junior Year, First Semester, 2 credits.

Mine. 22. Power Generation and Transmission in Mines.

Preparation required: Mine. 21.

Junior Year, Second Semester, 2 credits.

Mine. 23. Mine Drainage and Pumping.

Preparation required: Mine. 21, 22.

Senior Year, First Semester, 2 credits.

Mine. 24. Mine Hoisting and Haulage.

Preparation required: Mine. 21, 22.

Senior Year, Second Semester, 2 credits.

Mine. 25. Drilling, Boring, Excavating, etc.

Preparation required: Mine. 1, 2, 21, 22.

Senior Year, First Semester, 2 credits.

Mine. 26. Shaft Sinking.

Preparation required: Mine. 25.

Senior Year, Second Semester, 2 credits.

Mine. 27. Supporting or Timbering.

Preparation required: Mine. 1, 2, 37, 44, 45.

Senior Year, Second Semester, 2 credits.

Mine. 28. Exploitation.

Preparation required: Mine. 25; M. Geol. 5, 6. Taken with Mine. 26.

Senior Year, Second Semester, 2 credits.

Mine. 29. Mine Prospecting, Sampling, Valuation, etc.

Preparation required: Mine. 1, 2, 44, 45 and 5, 6 or 7, 8; M. Geol. 5, 6, 7, 8.

Senior Year, First Semester, 2 credits.

Mine. 30. Mine Accidents, their Causes, Prevention, etc.

Preparation required: Mine 1, 2, 5, 6 or 7, 8, 32; Law 1, 2. Taken with Mine. 34.

Senior Year, Second Semester, 2 credits.

Mine. 31. Mine Explosives—Their Care and Use.

Preparation required: 186, 187; Mine. 1, 2, 13, 14.

Senior Year, First Semester, 2 credits.

Mine. 32. First Aid to the Injured.

Preparation required: Mine. 1, 2; 5, 6 or 7, 8.

Taken with Mine. 31.

Senior Year, First Semester, 2 credits.

Mine. 33. Mine Labor, Strikes, Legislation, Care, and Education of the Miners, etc.

Preparation required: 7a or 7b, 25 or 33, 60 or 61, 64, 70; Mine. 1, 2, 17, 18; Law 1, 2.

Senior Year, First Semester, 2 credits.

Mine. 34. Mine Labor, Strikes, Legislation, Care, and Education of the Miners, etc.

Preparation required: Mine. 33.

Senior Year, Second Semester, 2 credits.

Mine. 35. Mining for Petroleum, Natural Gas, Asphaltum, and other Hydro-Carbons.

Preparation required: Mine. 5, 6. Taken with M. Geol. 18.

Senior Year, First Semester, 2 credits.

Mine. 36. Mining for Petroleum, Natural Gas, Asphaltum, and other Hydro-Carbons.

Preparation required: Mine. 35. Taken with M. Geol. 19.

Senior Year, Second Semester, 2 credits.

Mine. 37. Mine Timber.

Preparation required: 225, 226 or 229; or Geol. 7.

Senior Year, First Semester, 2 credits.

Mine. 38. Hydraulic Mining and Dredging.

Preparation required: Mine. 1, 2; M. Geol. 1, 2, 5, 6. Taken with M. Geol. 7.

Junior Year, First Semester, 2 credits.

Mine. 39. Hydraulic Mining and Dredging.

Preparation required: Mine. 38.

Junior Year, Second Semester, 2 credits.

Mine. 40. Deep Mining—Ventilation, Heat, Hoisting, Labor, etc.

Preparation required: Mine. 12.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 41. Deep Mining—Ventilation, Heat, Hoisting, Labor, etc.

Preparation required: Mine. 40.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 42. Advanced Mining Engineering.

Preparation required: Mine. 12.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 43. Advanced Mining Engineering.

Preparation required: Mine. 42.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 44. Mining Laboratory and Design.

Preparation required: 370, 371. Taken with 173; Mine. 1.

Sophomore Year, First Semester, 2 credits.

Mine. 45. Mining Laboratory and Design.

Preparation required: 371; Mine. 44. Taken with Mine. 2.

Sophomore Year, Second Semester, 2 credits.

Mine. 46. Mining Laboratory and Design.

Preparation required: Mine. 45. Taken with Mine. 5 or 7.

Junior Year, First Semester, 2 credits.

Mine. 47. Mining Laboratory and Design.

Preparation required: Mine. 46. Taken with Mine. 6 or 8.

Junior Year, Second Semester, 2 credits.

Mine. 48. Mining Laboratory and Design.

Preparation required: Mine. 47.

Senior Year, First Semester, 2 credits.

Mine. 49. Mining Laboratory and Design.

Preparation required: Mine. 48.

Senior Year, Second Semester, 2 credits.

Mine. 50. Mining Laboratory and Design.

Taken with Mine. 44.

Sophomore Year, First Semester, 1 to 12 credits.

Mine. 51. Mining Laboratory and Design.

Taken with Mine. 45.

Sophomore Year, Second Semester, 1 to 12 credits.

- Mine. 52. Mining Laboratory and Design.
Taken with Mine. 46.
Junior Year, First Semester, 1 to 12 credits.
- Mine. 53. Mining Laboratory and Design.
Taken with Mine. 47.
Junior Year, Second Semester, 1 to 12 credits.
- Mine. 54. Mining Laboratory and Design.
Taken with Mine. 48.
Senior Year, First Semester, 1 to 12 credits.
- Mine. 55. Mining Laboratory and Design.
Taken with Mine. 49.
Senior Year, Second Semester, 1 to 12 credits.
- Mine. 56. Mining Laboratory and Design.
Preparation required: Mine. 49.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 57. Mining Laboratory and Design.
Preparation required: Mine. 56.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 58. Practical Work in Mining.
Preparation required: 169, 172, 370; M. Geol. 1, 2.
Freshman Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Mine. 59. Practical Work in Mining.
Preparation required: Mine. 58.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Mine. 60. Practical Work in Mining.
Preparation required: Mine. 59.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Mine. 61. Practical Work in Mining.
Preparation required: Mine. 60.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Mine. 62. Practical Work in Mining.
Preparation required: Mine. 61.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Mine. 63. Research Work in Mining.
Preparation required: Mine. 5, 6, 7, 8 or 9, 10, 11, 12.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 64. Research Work in Mining.
Preparation required: Mine. 63.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 65. Electricity Applied to Mining.
Preparation required: Mine. 1, 2,
Junior Year, First Semester, 2 credits.

- Mine. 66. Electricity Applied to Mining.
Preparation required: Mine. 1, 2.
Junior Year, Second Semester, 2 credits.
- Mine. 67. Electricity Applied to Mining.
Preparation required: Mine. 66.
Senior Year, First Semester, 2 credits.
- Mine. 68. Electricity Applied to Mining.
Preparation required: Mine 67.
Senior Year, Second Semester, 2 credits.
- Mine. 69. Research Work in Coal Mining.
Preparation required: Mine. 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 70. Research Work in Coal Mining.
Preparation required: Mine. 69.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 71. Research Work in Metal Mining.
Preparation required: Mine. 7, 8.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 72. Research Work in Metal Mining.
Preparation required: Mine. 71.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 73. Research Work in Mine Gases.
Preparation required: 187, 188, 190. Mine 13, 14.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 74. Research Work in Mine Gases.
Preparation required: Mine. 73.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 75. Research Work in Mine Ventilation.
Preparation required: Mine. 13, 14, 19, 20.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 76. Research Work in Mine Ventilation.
Preparation required: Mine 75.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 77. Research Work in Mine Illumination.
Preparation required: 210; Mine. 13, 14.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 78. Research Work in Mine Illumination.
Preparation required: Mine. 77.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 79. Research Work on Mining Machinery.
Preparation required: Mine 19, 20, 21, 22.
Graduate Work, First Semester, 2 to 20 credits.

- Mine. 80. Research Work on Mining Machinery.
Preparation required: Mine 79.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 81. Research Work in Power Generation and Transmission.
Preparation required: Mine 21, 22.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 82. Research Work in Power Generation and Transmission.
Preparation required: Mine. 81.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 83. Research Work in Mine Drainage and Pumping.
Preparation required: Mine. 23, 24.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 84. Research Work in Mine Drainage and Pumping.
Preparation required: Mine. 83.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 85. Research Work in Mine Hoisting and Haulage.
Preparation required: Mine. 24, 25.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 86. Research Work in Mine Hoisting and Haulage.
Preparation required: Mine 85.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 87. Research Work in Drilling, Boring, Excavating, etc.
Preparation required: Mine. 25.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 88. Research Work in Drilling, Boring, Excavating, etc.
Preparation required: Mine. 87.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 89. Research Work in Shaft Sinking.
Preparation required: Mine, 25, 26.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 90. Research Work in Shaft Sinking.
Preparation required: Mine. 89.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 91. Research Work in Mine Supporting or Timbering.
Preparation required: Mine. 27, 37.
Graduate Work, First Semester, 2 to 20 credits.
- Mine. 92. Research Work in Mine Supporting and Timbering.
Preparation required: Mine. 91.
Graduate Work, Second Semester, 2 to 20 credits.
- Mine. 93. Research Work in Mine Exploitation.
Preparation required: Mine. 28.
Graduate Work, First Semester, 2 to 20 credits.

Mine. 94. Research Work in Mine Exploitation.

Preparation required: Mine. 93.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 95. Research Work in Mine Prospecting, Sampling, Valuation, etc.

Preparation required: Mine. 29.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 96. Research Work in Mine Prospecting, Sampling, Valuation, etc.

Preparation required: Mine. 95.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 97. Research Work upon Mine Accidents, their Causes, Prevention, etc.

Preparation required: Mine. 30, 31.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 98. Research Work upon Mine Accidents, their Causes, Prevention, etc.

Preparation required: Mine. 97.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 99. Research Work in Mining for Petroleum, Natural Gas, and other Hydro-Carbons.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 100. Research Work in Mining for Petroleum, Natural Gas, and other Hydro-Carbons.

Preparation required: Mine. 99.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 101. Research Work upon Mine Timbers and other Mine Supports.

Preparation required: Mine. 27, 37.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 102. Research Work upon Mine Timbers and other Mine Supports.

Preparation required: Mine. 101.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 103. Research Work in Hydraulic Mining and Dredging.

Preparation required: Mine. 38, 39.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 104. Research Work in Hydraulic Mining and Dredging.

Preparation required: Mine. 103.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 105. Research Work upon the Application of Electricity to Mining.

Preparation required: 210, 211, 212, 214, 330, 331; Mine. 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 65, 66, 67, 68.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 106. Research Work upon the Application of Electricity to Mining.

Preparation required: Mine. 105.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 107. Stone Quarrying and Open Work Mining.

Preparation required: Mine. 1, 2, 5, 6, 7, 8, 23, 25, 31.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 108. Stone Quarrying and Open Work Mining.

Preparation required: Mine. 107.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 109. Mining Education.

Preparation required: Mine. 1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 29, 30, 32, 33, 34, 44, 45, 46, 47, 58, 59.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 110. Mining Education.

Preparation required: Mine. 107.

Graduate Work, Second Semester, 2 to 20 credits.

Mine. 111. History of Mining.

Preparation required: Mine. 1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 29, 30, 32, 33, 34, 44, 45, 46, 47, 58, 59.

Graduate Work, First Semester, 2 to 20 credits.

Mine. 112. History of Mining.

Preparation required: Mine. 109.

Graduate Work, Second Semester, 2 to 20 credits.

VI. MINING (ECONOMIC) GEOLOGY

Under this heading will be discussed the geology of the useful or economic mineral products, considered from two different points of view: First, their origin and modes of occurrence; second, their uses. Special attention is given throughout the course to the instruction of the student in Mineralogy, Petrography, and Geology, in order that he may in his future work understand the nature of the deposits upon which he may be employed, since, in the practice of a mining engineer, disastrous mistakes probably occur oftener through ignorance of the petrographical and geological relations of the ore deposits in question than from lack of engineering and metallurgical skill.

Here are discussed the origin, occurrence, and uses of various ores and the mineral substances used for construction, decoration, fire-resisting, building, cement, pottery, smelting, glass-making, attrition, burning, illustration, lubrication, painting, fertilizing, pyrotechnics, medicines, in chemistry, etc. In general, it may be said that, while it is not intended to neglect any subject properly belonging to Mining Geology, yet, owing to the location of this School, particular attention will be given to the occurrence and use of stone, clay, lime, cement, coal, iron ore, and other economic products worked in the State.

M. Geol. 1. The Principles of Mining Geology.

Taken with 185, 194; Min. 1; Geol. 5.

Freshman Year, First Semester, 2 credits.

M. Geol. 2. Mining Geology continued.

Preparation required: Mine. 1; Geol. 5; M. Geol. 1. Taken with Min. 2; Geol. 6.

Freshman Year, Second Semester, 2 credits.

In M. Geol. 1 and 2 are taken up the classification of the Utilities or the useful mineral and geological products, their origin, mode of occurrence, uses, associations and methods of prospecting. They give an elementary survey of the entire field and serve as an introduction to the various other subjects of Mining Geology given in the School of Mines.

M. Geol. 3. Memetallites or Non-Metalliferous Deposits. (Structural Materials).

Preparation required: Geol. 5, 6; M. Geol. 1, 2. Taken with Mine. 1.

Sophomore Year, First Semester, 2 credits.

M. Geol. 4. Building and Ornamental Stones and Road Materials (Structural Materials).

Preparation required: M. Geol. 2; Pet. 1, 9. Taken with Mine. 2; Pet. 2, 10.

Sophomore Year, Second Semester, 2 credits.

M. Geol. 4 is intended with M. Geol. 1, 2, and 3 to take up quite fully the subject of the geological materials of construction. It should be supplemented by M. Geol. 5, 6, 7, 8, 9, 10, 11, 12, 13; Mine. 37, and Met. 15, 16, 17 and 18.

M. Geol. 5. Metallites or Metalliferous Deposits.

Preparation required: M. Geol. 1; Mine. 1, 2. Taken with Pet. 1.

Sophomore Year, First Semester, 2 credits.

M. Geol. 6. Metallites or Metalliferous Deposits.

Preparation required: M. Geol. 5. Taken with Pet. 2.

Sophomore Year, Second Semester, 2 credits.

M. Geol. 7. Ore Deposits of the United States.

Preparation required: M. Geol. 5, 6. Taken with Pet. 3.

Junior Year, First Semester, 2 credits.

M. Geol. 8. Ore Deposits of the United States.

Preparation required: M. Geol. 7. Taken with Pet. 4.

Junior Year, Second Semester, 2 credits.

M. Geol. 9. Clays—Their Origin, Occurrence, Properties, and Uses.

Preparation required: M. Geol. 1, 2. Taken with Mine. 1; Pet. 1, 9.

Sophomore Year, First Semester, 2 credits.

M. Geol. 10. Clays—Their Origin, Occurrence, Properties, and Uses.

Preparation required: M. Geol. 1, 2. Taken with Mine. 2; Pet. 2, 10.

Sophomore Year, Second Semester, 2 credits.

- M. Geol. 11. Lime, Plaster, and Cement Materials—Their Occurrence, Properties, and Uses.
Preparation required. M. Geol. 1, 2. Taken with Mine. 1; Pet. 1, 9.
Sophomore Year, First Semester, 2 credits.
- M. Geol. 12. Lime, Plaster, and Cement Materials—Their Occurrence, Properties, and Uses.
Preparation required: M. Geol. 11. Taken with Pet. 2, 10.
Sophomore Year, Second Semester, 2 credits.
- M. Geol. 13. Materials for Glazes, Enamels, Colors, Fluxes, and Glass Making (2).
Preparation required: M. Geol. 9.
Sophomore Year, Second Semester, 2 credits.
- M. Geol. 14. Precious Stones or Gems.
Preparation required: M. Geol. 1, 2, 3, 4; Mine. 1, 2; Pet. 1, 2, 3, 4.
Taken with Pet. 5, 13.
Senior Year, First Semester, 2 credits.
- M. Geol. 15. Precious Stones or Gems.
Preparation required: M. Geol. 14. Taken with Pet. 6, 14.
Senior Year, Second Semester, 2 credits.
- M. Geol. 16. Coal and Peat—Their Origin, Occurrence, Distribution, Properties, and Uses.
Preparation required: Mine. 1, 2; M. Geol. 3; Pet. 1, 2. Taken with Mine. 5; Pet. 3, 11.
Junior Year, First Semester, 2 credits.
- M. Geol. 17. Coal and Peat—Their Origin, Occurrence, Distribution, Properties, and Uses.
Preparation required: M. Geol. 16. Taken with Mine. 6; Pet. 4, 12.
Junior Year, Second Semester, 2 credits.
- M. Geol. 18. Petroleum, Natural Gas, Asphaltum, and other Hydro-Carbons.
Preparation required: Mine. 1, 2; M. Geol. 16, 17. Taken with Mine. 35.
Senior Year, First Semester, 2 credits.
- M. Geol. 19. Petroleum, Natural Gas, Asphaltum, and other Hydro-Carbons.
Preparation required: M. Geol. 18; Mine. 35. Taken with Mine. 36.
Senior Year, Second Semester, 2 credits.
- M. Geol. 20. Mineral Fertilizers.
Preparation required: 187, 188; Geol. 9, 10; M. Geol. 1, 2, 3; Mine. 1, 2; Pet. 1, 2, 3, 4, 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 21. Mineral Fertilizers.
Preparation required: M. Geol. 20.
Graduate Work, Second Semester, 2 to 20 credits.

- M. Geol. 22. Iron and Manganese Deposits.
Preparation required: M. Geol. 1, 2, 5, 6; Pet. 1, 2. Taken with M. Geol. 7; Pet. 3, 11.
Junior Year, First Semester, 2 credits.
- M. Geol. 23. Iron and Manganese Deposits.
Preparation required: M. Geol. 22. Taken with M. Geol. 8; Pet. 4, 12.
Junior Year, Second Semester, 2 credits.
- M. Geol. 24. Saline Deposits.
Preparation required: Mine. 1, 2; M. Geol. 1, 2, 3.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 25. Saline Deposits.
Preparation required: M. Geol. 24.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 26. Copper Deposits.
Preparation required: Mine. 7, 8; M. Geol. 5, 6; Pet. 4, 12.
Taken with Pet. 5, 13.
Senior Year, First Semester, 2 credits.
- M. Geol. 27. Copper Deposits.
Preparation required: M. Geol. 26. Taken with Pet. 6, 14.
Senior Year, Second Semester, 2 credits.
- M. Geol. 28. Gold, Silver, and Silver Lead Deposits.
Preparation required: Mine. 7, 8; M. Geol. 5, 6; Pet. 4, 12.
Taken with Pet. 5, 6.
Senior Year, First Semester, 2 credits.
- M. Geol. 29. Gold, Silver, and Silver Lead Deposits.
Preparation required: M. Geol. 28. Taken with Pet. 6, 14.
Senior Year, Second Semester, 2 credits.
- M. Geol. 30. Lead and Zinc Deposits.
Preparation required: Mine. 7, 8; M. Geol. 29; Pet. 5, 6, 13, 14.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 31. Lead and Zinc Deposits.
Preparation required: M. Geol. 30.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 32. Chromium, Bismuth, Nickel, Cobalt, Platinum, and other Minor Deposits.
Preparation required: Mine. 1, 2, 7, 8; Pet. 5, 6, 13, 14.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 33. Chromium, Bismuth, Nickel, Cobalt, Platinum, and other Minor Deposits.
Preparation required: M. Geol. 32.
Graduate Work, Second Semester, 2 to 20 credits.

- M. Geol. 34. Mining Geology of Pennsylvania.
Preparation required: M. Geol. 7, 8.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 35. Mining Geology of Pennsylvania.
Preparation required: M. Geol. 34.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 36. Genesis of Ore Deposits.
Preparation required: M. Geol. 5, 6, 7, 8; Pet. 4. Taken with Pet. 5, 13.
Senior Year, First Semester, 2 credits.
- M. Geol. 37. Genesis of Ore Deposits.
Preparation required: M. Geol. 36. Taken with Pet. 6, 14.
Senior Year, Second Semester, 2 credits.
- M. Geol. 38. Mining Geological Laboratory.
Preparation required: M. Geol. 1, 2. Taken with M. Geol. 3, or 5, or 9, or 11.
Sophomore Year, First Semester, 2 to 12 credits.
- M. Geol. 39. Mining Geological Laboratory.
Preparation required: M. Geol. 38. Taken with M. Geol. 4, or 6, or 10, or 12, or 13.
Sophomore Year, Second Semester, 2 to 12 credits.
- M. Geol. 40. Mining Geological Laboratory.
Preparation required: M. Geol. 39. Taken with M. Geol. 7, or 16, or 22.
Junior Year, First Semester, 2 to 12 credits.
- M. Geol. 41. Mining Geological Laboratory.
Preparation required: M. Geol. 40. Taken with M. Geol. 8, or 17, or 23.
Junior Year, Second Semester, 2 to 12 credits.
- M. Geol. 42. Mining Geological Laboratory.
Preparation required: M. Geol. 41. Taken with M. Geol. 14, or 18, or 26, or 28, or 36.
Senior Year, First Semester, 2 to 12 credits.
- M. Geol. 43. Mining Geological Laboratory.
Preparation required: M. Geol. 42. Taken with M. Geol. 15, or 19, or 27, or 29, or 37.
Senior Year, Second Semester, 2 to 12 credits.
- M. Geol. 44. Mining Geological Laboratory.
Preparation required: M. Geol. 43.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 45. Mining Geological Laboratory.
Preparation required: M. Geol. 44.
Graduate Work, Second Semester, 2 to 20 credits.

- M. Geol. 46. Practical Work in Mining Geology.
Preparation required: M. Geol. 1, 2.
Freshman Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- M. Geol. 47. Practical Work in Mining Geology.
Preparation required: M. Geol. 1, 2, 46, and 3, 4, or 5, 6, or 9, 10, or 11, 12.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- M. Geol. 48. Practical Work in Mining Geology.
Preparation required: M. Geol. 47.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- M. Geol. 49. Practical Work in Mining Geology.
Preparation required: M. Geol. 48.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- M. Geol. 50. Practical Work in Mining Geology.
Preparation required: M. Geol. 49.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- M. Geol. 51. Research Work in Mining Geology.
Preparation required: M. Geol. 5, 6, 7, 8.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 52. Research Work in Mining Geology.
Preparation required: M. Geol. 51.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 53. Research Work upon the Ore Deposits of Europe.
Preparation required: M. Geol. 7, 8.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 54. Research Work upon the Ore Deposits of Europe, Africa, etc.
Preparation required: M. Geol. 53.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 55. Research Work upon Abrasives and Refractory Materials
Preparation required: M. Geol. 1, 2, 3; Pet. 1, 2, 3, 4, 9, 10, 11, 12.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 56. Research Work upon Abrasives and Refractory Materials.
Preparation required: M. Geol. 55.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 57. Research Work upon Building and Ornamental Stones.
Preparation required: 187, 188; M. Geol. 1, 2, 3, 4; Pet. 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 58. Research Work upon Building and Ornamental Stones.
Preparation required: M. Geol. 57.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 59. Research Work upon Clays and Clay Deposits.
Preparation required: 187, 188; M. Geol. 9, 10; Pet. 5, 6.
Graduate Work, First Semester, 2 to 20 credits.

- M. Geol. 60. Research Work upon Clays and Clay Deposits.
Preparation required: M. Geol. 59.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 61. Research Work in Limes, Plasters, and Cements.
Preparation required: 187, 188; M. Geol. 11, 12; Pet. 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 62. Research Work in Limes, Plasters, and Cements.
Preparation required: M. Geol. 61.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 63. Research Work upon Coal, its Origin, etc.
Preparation required: 187, 188, 190; M. Geol. 16, 17; Mine. 5, 6;
Pet. 5, 6.*
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 64. Research Work upon Coal, its Origin, etc.
Preparation required: M. Geol. 63.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 65. Research Work upon the Geology and Uses of Water.
Preparation required: 198; M. Geol. 1, 2, 3, 4.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 66. Research Work upon the Geology and Uses of Water.
Preparation required: M. Geol. 65.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 67. Research Work upon the Mining Geology of Pigments,
Mineral Medicines, etc.
Preparation required: 187; M. Geol. 1, 2, 3, 4; Pet. 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 68. Research Work upon the Mining Geology of Pigments,
Mineral Medicines, etc.
Preparation required: M. Geol. 67.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 69. Research Work upon Tin and Mercury Deposits.
Preparation required: M. Geol. 5, 6, 7, 8; Pet. 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 70. Research Work upon Tin and Mercury Deposits.
Preparation required: M. Geol. 67; Pet. 5, 6.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 71. Research Work upon Aluminum, Sulphur, Vanadium,
Barium, and other Minor Deposits.
Preparation required: M. Geol. 5, 6, 7, 8; Pet. 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 72. Research Work upon Aluminum, Sulphur, Vanadium,
Barium and other Minor Deposits.
Preparation required: M. Geol. 71.
Graduate Work, Second Semester, 2 to 20 credits.

- M. Geol. 73. Research Work upon Petroleum and Natural Gas Deposits.
Preparation required: M. Geol. 18, 19.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 74. Research Work upon Petroleum and Natural Gas Deposits.
Preparation required: M. Geol. 73.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 75. Research Work upon Precious Stones or Gems, their Origin, Mode of Occurrence, etc.
Preparation required: M. Geol. 10, 11; Mine. 1, 2, 38, 39; Pet. 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 76. Research Work upon Precious Stones or Gems, their Origin, Mode of Occurrence, etc.
Preparation required: M. Geol. 75.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 77. Research Work upon Asphaltum and other Hydro-Carbon Deposits.
Preparation required: M. Geol. 35, 36.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 78. Research Work upon Asphaltum and other Hydro-Carbon Deposits.
Preparation required: M. Geol. 77.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 79. Research Work upon Iron and Manganese Deposits.
Preparation required: Mine. 7, 8; M. Geol. 22, 23.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 80. Research Work upon Iron and Manganese Deposits.
Preparation required: M. Geol. 79.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 81. Research Work upon Copper Deposits.
Preparation required: Mine. 7, 8; M. Geol. 26, 27.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 82. Research Work upon Copper Deposits.
Preparation required: M. Geol. 81.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 83. Research Work upon Gold, Silver, and Silver-Lead Deposits.
Preparation required: M. Geol. 83.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 84. Research Work upon Gold, Silver, and Silver-Lead Deposits.
Preparation required: M. Geol. 83.
Graduate Work, Second Semester, 2 to 20 credits.

- M. Geol. 85. Research Work upon the Genesis of Memetallites or Non-Metallic Deposits.
Preparation required: Mine. 5, 6; M. Geol. 35, 36.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 86. Research Work upon the Genesis of Memetallites or Non-Metallic Deposits.
Preparation required: M. Geol. 85.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 87. Research Work upon the Genesis of Metallites or Ore Deposits.
Preparation required: Mine. 7, 8; M. Geol. 35, 36.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 88. Research Work upon the Genesis of Metallites or Ore Deposits.
Preparation required: M. Geol. 87.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 89. Education in Mining Geology.
Preparation required: M. Geol. 1, 2, 3, 4, 5, 6, 7, 8, 36, 37, 46, 47, 48, 49.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 90. Education in Mining Geology.
Preparation required: M. Geol. 89.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Geol. 91. History of Mining Geology.
Preparation required: M. Geol. 1, 2, 3, 4, 5, 6, 7, 8, 36, 37, 46, 47, 48, 49.
Graduate Work, First Semester, 2 to 20 credits.
- M. Geol. 92. History of Mining Geology.
Preparation required: M. Geol. 91.
Graduate Work, Second Semester, 2 to 20 credits.

VII. MINING LAW

- Law 1. Principles of Law, and Mining Law.
Preparation required: M. Geol. 1, 2; Mine. 1, 2.
Junior Year, First Semester, 2 credits.
- Law 2. Mining Law and Law of Mining Injuries.
Preparation required: Law 1.
Junior Year, Second Semester, 2 credits.
- Law 3. Advanced Mining Law.
Preparation required: Law 2.
Senior Year, First Semester, 2 credits.
- Law 4. Advanced Mining Law.
Preparation required: Law 3.
Senior Year, Second Semester, 2 credits.

- Law 5. Law Relating to Oil and Gas.
Preparation required: Law 2.
Senior Year, First Semester, 2 credits.
- Law 6. Law Relating to Oil and Gas.
Preparation required: Law 5.
Senior Year, Second Semester, 2 credits.
- Law 7. Introduction to American Law and the Law of Contracts, Limitations, and Frauds as Applied to Mining.
Preparation required: Law 3, 4.
Graduate Work, First Semester, 2 credits.
- Law 8. Introduction to American Law and the Law of Contracts, Limitations, and Frauds as Applied to Mining.
Preparation required: Law 7.
Graduate Work, Second Semester, 2 credits.
- Law 9. The Law of Negligence and of Personal Injuries in Mines.
Preparation required: Law 1, 2. Taken with Law 7.
Graduate Work, First Semester, 2 credits.
- Law 10. The Law of Negligence and of Personal Injuries in Mines.
Preparation required: Law 9. Taken with Law 8.
Graduate Work, Second Semester, 2 credits.
- Law 11. The Law of Mining Operations.
Preparation required: Law 3, 4, 5, 6. Taken with Law 7.
Graduate Work, First Semester, 2 credits.
- Law 12. The Law of Mining Operations.
Preparation required: Law 11. Taken with Law 8.
Graduate Work, Second Semester, 2 credits.
- Law 13. Mining Laws of Great Britain.
Preparation required: Law 1, 2, 3, 4, 5, 6.
Graduate Work, First Semester, 2 credits.
- Law 14. Mining Laws of Great Britain.
Preparation required: Law 13.
Graduate Work, Second Semester, 2 credits.
- Law 15. Mining Laws of Mexico and other Foreign Countries.
Preparation required: Law 1, 2, 3, 4, 5, 6.
Graduate Work, First Semester, 2 credits.
- Law 16. Mining Laws of Mexico and other Foreign Countries.
Preparation required: Law 15.
Graduate Work, Second Semester, 2 credits.
- Law 17. Critical Study of Mining Law.
Preparation required: Law 1, 2, 3, 4, 5, 6. Taken with Law 7, 9.
Graduate Work, First Semester, 2 to 20 credits.
- Law 18. Critical Study of Mining Law.
Preparation required: Law 17. Taken with Law 8, 10.
Graduate Work, Second Semester, 2 to 20 credits.

Law 19. Education in Mining Law.

Preparation required: Law 1, 2, 3, 4, 5, 6.

Graduate Work, First Semester, 2 to 20 credits.

Law 20. Education in Mining Law.

Preparation required: Law 19.

Graduate Work, Second Semester, 2 to 20 credits.

Law 21. History of Mining Law.

Preparation required: Law 1, 2, 3, 4, 5, 6.

Graduate Work, First Semester, 2 to 20 credits.

Law 22. History of Mining Law.

Preparation required: Law 21.

Graduate Work, Second Semester, 2 to 20 credits.

VIII. MINING SURVEYING

M. Sur. 1. Mine Surveying.

Preparation required: 172.

Sophomore Year, First Semester, 2 credits.

M. Sur. 2. Mine Surveying.

Preparation required: M. Sur. 1.

Sophomore Year, Second Semester, 2 credits.

M. Sur. 3. Mine Surveying.

Preparation required: M. Sur. 2.

Junior Year, First Semester, 2 credits.

M. Sur. 4. Mine Surveying.

Preparation required: M. Sur. 3.

Junior Year, Second Semester, 2 credits.

M. Sur. 5. Mine Surveying.

Preparation required: M. Sur. 4.

Senior Year, First Semester, 2 credits.

M. Sur. 6. Mine Surveying.

Preparation required: M. Sur. 5.

Senior Year, Second Semester, 2 credits.

M. Sur. 7. Practical Work in Surveying.

Preparation required: 172.

Freshman Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

M. Sur. 8. Practical Work in Surveying.

Preparation required: M. Sur. 7.

Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

M. Sur. 9. Practical Work in Surveying.

Preparation required: M. Sur. 8.

Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

- M. Sur. 10. Practical Work in Surveying.
Preparation required: M. Sur. 9.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- M. Sur. 11. Practical Work in Surveying.
Preparation required: M. Sur. 1, 2, 7.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- M. Sur. 12. Research Work in Mining Surveying, Instruments, Methods, etc.
Preparation required: M. Sur. 1, 2, 7.
Graduate Work, First Semester, 2 to 20 credits.
- M. Sur. 13. Research Work in Mining Surveying, Instruments, Methods, etc.
Preparation required: M. Sur. 12.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Sur. 14. Education in Mining Surveying.
Preparation required: M. Sur. 1, 2, 7.
Graduate Work, First Semester, 2 to 20 credits.
- M. Sur. 15. Education in Mining Surveying.
Preparation required: M. Sur. 14.
Graduate Work, Second Semester, 2 to 20 credits.
- M. Sur. 16. History of Mining Surveying.
Preparation required: M. Sur. 1, 2, 7.
Graduate Work, First Semester, 2 to 20 credits.
- M. Sur. 17. History of Mining Surveying.
Preparation required: M. Sur. 16.
Graduate Work, Second Semester, 2 to 20 credits.

IX. ORE DRESSING AND COAL WASHING

- Ore 1. Principles of Ore Dressing and Coal Washing.
Preparation required: Min. 1, 2; Geol. 5, 6; M. Geol. 1, 2. Taken with Met. 1.
Sophomore Year, First Semester, 2 credits.

This subject deals briefly with the machinery used for ore concentration and coal washing, and also takes up the methods of ore dressing and the plants used. In this subject are considered the theoretical principles involved in the concentration and preparation for the smelters of gold, silver, lead, copper, iron, zinc, and other ores, as well as the washing of coal, clay, etc., and their preparation for market.

- Ore 2. Ore Dressing Operations and Machinery.
Preparation required: Ore 1.
Sophomore Year, Second Semester, 2 credits.

Ore 3. Ore Dressing Operations and Machinery.

Preparation required: Ore 2.

Junior Year, First Semester, 2 credits.

Ore 4. Ore Dressing Operations and Machinery.

Preparation required: Ore 3.

Junior Year, Second Semester, 2 credits.

Ore 5. Gold and Silver Milling.

Preparation required: Ore 4.

Senior Year, First Semester, 2 credits.

Ore 6. Gold and Silver Milling.

Preparation required: Ore 5.

Senior Year, Second Semester, 2 credits.

Ore 7. Coal Washing and Preparation for Market.

Preparation required: Ore 1.

Sophomore Year, Second Semester, 2 credits.

Ore 8. Coal Washing and Preparation for Market.

Preparation required: Ore 7.

Junior Year, First Semester, 2 credits.

Ore 9. Coal Washing and Preparation for Market.

Preparation required: Ore 8.

Junior Year, Second Semester, 2 credits.

Ore 10. Coal Washing and Preparation for Market.

Preparation required: Ore 9.

Senior Year, First Semester, 2 credits.

Ore 11. Coal Washing and Preparation for Market.

Preparation required: Ore 10.

Senior Year, Second Semester, 2 credits.

Ore 12. Ore Dressing Laboratory.

Taken with Ore 1.

Sophomore Year, First Semester, 2 credits.

Ore 13. Ore Dressing Laboratory.

Preparation required: Ore 12. Taken with Ore 2 or 7.

Sophomore Year, Second Semester, 2 credits.

Ore 14. Ore Dressing Laboratory.

Preparation required: Ore 13. Taken with Ore 3 or Ore 8.

Junior Year, First Semester, 2 credits.

Ore 15. Ore Dressing Laboratory.

Preparation required: Ore 14. Taken with Ore 4 or Ore 9.

Junior Year, Second Semester, 2 credits.

Ore 16. Ore Dressing Laboratory.

Preparation required: Ore 15. Taken with Ore 5 or Ore 10.

Senior Year, First Semester, 2 credits.

- Ore 17. Ore Dressing Laboratory.
Preparation required: Ore 16. Taken with Ore 6 or Ore 11.
Senior Year, Second Semester, 2 credits.
- Ore 18. Ore Dressing Laboratory.
Taken with Ore 12.
Sophomore Year, First Semester, 1 to 12 credits.
- Ore 19. Ore Dressing Laboratory.
Taken with Ore 13.
Sophomore Year, Second Semester, 1 to 12 credits.
- Ore 20. Ore Dressing Laboratory.
Taken with Ore 14.
Junior Year, First Semester, 1 to 12 credits.
- Ore 21. Ore Dressing Laboratory.
Taken with Ore 15.
Junior Year, Second Semester, 1 to 12 credits.
- Ore 22. Ore Dressing Laboratory.
Taken with Ore 16.
Senior Year, First Semester, 1 to 12 credits.
- Ore 23. Ore Dressing Laboratory.
Taken with Ore 17.
Senior Year, Second Semester, 1 to 12 credits.
- Ore 24. Coal Washing Laboratory.
Taken with Ore 1.
Sophomore Year, First Semester, 2 credits.
- Ore 25. Coal Washing Laboratory.
Preparation required: Ore 24. Taken with Ore 7.
Sophomore Year, Second Semester, 2 credits.
- Ore 26. Coal Washing Laboratory.
Preparation required: Ore 25. Taken with Ore 8.
Junior Year, First Semester, 2 credits.
- Ore 27. Coal Washing Laboratory.
Preparation required: Ore 26. Taken with Ore 9.
Junior Year, Second Semester, 2 credits.
- Ore 28. Coal Washing Laboratory.
Preparation required: Ore 27. Taken with Ore 10.
Senior Year, First Semester, 2 credits.
- Ore 29. Coal Washing Laboratory.
Preparation required: Ore 28. Taken with Ore 11.
Senior Year, Second Semester, 2 credits.
- Ore 30. Coal Washing Laboratory.
Taken with Ore 24.
Sophomore Year, First Semester, 1 to 12 credits.

- Ore 31. Coal Washing Laboratory.
Taken with Ore 25.
Sophomore Year, Second Semester, 1 to 12 credits.
- Ore 32. Coal Washing Laboratory.
Taken with Ore 26.
Junior Year, First Semester, 1 to 12 credits.
- Ore 33. Coal Washing Laboratory.
Taken with Ore 27.
Junior Year, Second Semester, 1 to 12 credits.
- Ore 34. Coal Washing Laboratory.
Taken with Ore 28.
Senior Year, First Semester, 1 to 12 credits.
- Ore 35. Coal Washing Laboratory.
Taken with Ore 29.
Senior Year, Second Semester, 1 to 12 credits.
- Ore 36. Research Work in Ore Dressing.
Preparation required: Ore 6.
Graduate Work, First Semester, 2 to 20 credits.
- Ore 37. Research Work in Ore Dressing.
Preparation required: Ore 36.
Graduate Work, Second Semester, 2 to 20 credits.
- Ore 38. Research Work in Coal Washing and Preparation for Market.
Preparation required: Ore 11.
Graduate Work, First Semester, 2 to 20 credits.
- Ore 39. Research Work in Coal Washing and Preparation for Market.
Preparation required: Ore 38.
Graduate Work, Second Semester, 2 to 20 credits.
- Ore 40. Practical Work in Ore Dressing.
Preparation required: Ore 1.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Ore 41. Practical Work in Ore Dressing.
Preparation required: Ore 40.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Ore 42. Practical Work in Ore Dressing.
Preparation required: Ore 41.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Ore 43. Practical Work in Ore Dressing.
Preparation required: Ore 42.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Ore 44. Practical Work in Coal Washing and Preparation for Market.
Preparation required: Ore 7.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

- Ore 45. Practical Work in Coal Washing and Preparation for Market.
Preparation required: Ore 44.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Ore 46. Practical Work in Coal Washing and Preparation for Market.
Preparation required: Ore 45.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Ore 47. Practical Work in Coal Washing and Preparation for Market.
Preparation required: Ore 46.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Ore 48. Research Work in Gold and Silver Milling.
Preparation required: Ore 5, 6.
Graduate Work, First Semester, 2 to 20 credits.
- Ore 49. Research Work in Gold and Silver Milling.
Preparation required: Ore 48.
Graduate Work, Second Semester, 2 to 20 credits.
- Ore 50. Practical Work in Gold and Silver Milling.
Preparation required: Ore 5, 6.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Ore 51. Education in Ore Dressing.
Preparation required: Ore 1, 2, 3, 4, 5, 6, 12, 13, 14, 15, 40, 41.
Graduate Work, First Semester, 2 to 20 credits.
- Ore 52. Education in Ore Dressing.
Preparation required: Ore 51.
Graduate Work, Second Semester, 2 to 20 credits.
- Ore 53. History of Ore Dressing.
Preparation required: Ore 1, 2, 3, 4, 5, 6, 12, 13, 14, 15, 40, 41.
Graduate Work, First Semester, 2 to 20 credits.
- Ore 54. History of Ore Dressing.
Preparation required: Ore 53.
Graduate Work, Second Semester, 2 to 20 credits.
- Ore 55. Education in Coal Washing.
Preparation required: Ore 7, 8, 9, 10, 11, 24, 25, 26, 27, 44, 45.
Graduate Work, First Semester, 2 to 20 credits.
- Ore 56. Education in Coal Washing.
Preparation required: Ore 55.
Graduate Work, Second Semester, 2 to 20 credits.
- Ore 57. History of Coal Washing.
Preparation required: Ore 7, 8, 9, 10, 11, 24, 25, 26, 27, 44, 45.
Graduate Work, First Semester, 2 to 20 credits.
- Ore 58. History of Coal Washing.
Preparation required: Ore 57.
Graduate Work, Second Semester, 2 to 20 credits.

X. PALEONTOLOGY

The object of these subjects is to familiarize the student in the field and laboratory with the more common fossils, particularly those that characterize the Paleozoic formations. Naturally, especial attention will be given to the Pennsylvania flora and fauna. The student will be practiced in the determination of various types which he is expected to draw and describe.

The class room work, with the associated laboratory work, is arranged largely for its use in prospecting and mining in the coal and other stratified formations.

The design is to acquaint the student with the distinguishing features of the more important groups of fossils, and to teach him the method of separating one formation from another by the aid of its fossil remains.

Pal. 1. Paleontology.

Preparation required: Entrance requirements in Zoology. Taken with Geol. 5.

Freshman Year, First Semester, 2 credits.

Pal. 2. Paleontology.

Preparation required: Pal. 1. Taken with Geol. 8.

Freshman Year, Second Semester, 2 credits.

Pal. 3. Paleontology.

Preparation required: Pal. 2. Taken with Geol. 13.

Sophomore Year, First Semester, 2 credits.

Pal. 4. Paleontology.

Preparation required: Pal. 3. Taken with Geol. 14.

Sophomore Year, Second Semester, 2 credits.

Pal. 5. Paleontology.

Preparation required: Pal. 4. Taken with Geol. 15.

Junior Year, First Semester, 2 credits.

Pal. 6. Paleontology.

Preparation required: Pal. 5. Taken with Geol. 16.

Junior Year, Second Semester, 2 credits.

Pal. 7. Paleontology.

Preparation required: Pal. 6.

Senior Year, First Semester, 2 credits.

Pal. 8. Paleontology.

Preparation required: Pal. 7.

Senior Year, Second Semester, 2 credits.

Pal. 9. Paleobotany.

Preparation required: Entrance requirements in Botany. Taken with Geol. 5.

Freshman Year, First Semester, 2 credits.

Pal. 10. Paleobotany.

Preparation required: Pal. 9. Taken with Geol. 8.
Freshman Year, Second Semester, 2 credits.

Pal. 11. Paleobotany.

Preparation required: Pal. 10. Taken with Geol. 13.
Sophomore Year, First Semester, 2 credits.

Pal. 12. Paleobotany.

Preparation required: Pal. 11. Taken with Geol. 14.
Sophomore Year, Second Semester, 2 credits.

Pal. 13. Paleobotany.

Preparation required: Pal. 12. Taken with Geol. 15.
Junior Year, First Semester, 2 credits.

Pal. 14. Paleobotany.

Preparation required: Pal. 13. Taken with Geol. 16.
Junior Year, Second Semester, 2 credits.

Pal. 15. Paleobotany.

Preparation required: Pal. 14.
Senior Year, First Semester, 2 credits.

Pal. 16. Paleobotany.

Preparation required: Pal. 15.
Senior Year, Second Semester, 2 credits.

Pal. 17. Paleontological Laboratory.

Taken with Pal. 1.
Freshman Year, First Semester, 1 to 12 credits.

Pal. 18. Paleontological Laboratory.

Preparation required: Pal. 1, 17. Taken with Pal. 2.
Freshman Year, Second Semester, 1 to 12 credits.

Pal. 19. Paleontological Laboratory.

Preparation required: Pal. 18. Taken with Pal. 3.
Sophomore Year, First Semester, 1 to 12 credits.

Pal. 20. Paleontological Laboratory.

Preparation required: Pal. 19. Taken with Pal. 4.
Sophomore Year, Second Semester, 1 to 12 credits.

Pal. 21. Paleontological Laboratory.

Preparation required: Pal. 20. Taken with Pal. 5.
Junior Year, First Semester, 1 to 12 credits.

Pal. 22. Paleontological Laboratory.

Preparation required: Pal. 21. Taken with Pal. 6.
Junior Year, Second Semester, 1 to 12 credits.

Pal. 23. Paleontological Laboratory.

Preparation required: Pal. 22. Taken with Pal. 7.
Senior Year, First Semester, 1 to 12 credits.

- Pal. 24. Paleontological Laboratory.
Preparation required: Pal. 23. Taken with Pal. 8.
Senior Year, Second Semester, 1 to 12 credits.
- Pal. 25. Paleontological Laboratory.
Preparation required: Pal. 24.
Graduate Work, First Semester, 2 to 20 credits.
- Pal. 26. Paleontological Laboratory.
Preparation required: Pal. 25.
Graduate Work, Second Semester, 2 to 20 credits.
- Pal. 27. Paleobotanical Laboratory.
Taken with Pal. 9.
Freshman Year, First Semester, 1 to 12 credits.
- Pal. 28. Paleobotanical Laboratory.
Preparation required: Pal. 27. Taken with Pal. 10.
Freshman Year, Second Semester, 1 to 12 credits.
- Pal. 29. Paleobotanical Laboratory.
Preparation required: Pal. 28. Taken with Pal. 11.
Sophomore Year, First Semester, 1 to 12 credits.
- Pal. 30. Paleobotanical Laboratory.
Preparation required: Pal. 29. Taken with Pal. 12.
Sophomore Year, Second Semester, 1 to 12 credits.
- Pal. 31. Paleobotanical Laboratory.
Preparation required: Pal. 30. Taken with Pal. 13.
Junior Year, First Semester, 1 to 12 credits.
- Pal. 32. Paleobotanical Laboratory.
Preparation required: Pal. 31. Taken with Pal. 14.
Junior Year, Second Semester, 1 to 12 credits.
- Pal. 33. Paleobotanical Laboratory.
Preparation required: Pal. 32. Taken with Pal. 15.
Senior Year, First Semester, 1 to 12 credits.
- Pal. 34. Paleobotanical Laboratory.
Preparation required: Pal. 33. Taken with Pal. 16.
Senior Year, Second Semester, 1 to 12 credits.
- Pal. 35. Paleobotanical Laboratory.
Preparation required: Pal. 34.
Graduate Work, First Semester, 2 to 20 credits.
- Pal. 36. Paleobotanical Laboratory.
Preparation required: Pal. 35.
Graduate Work, Second Semester, 2 to 20 credits.
- Pal. 37. Practical Work in Paleontology.
Preparation required: Pal. 18.
Freshman Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

- Pal. 38. Practical Work in Paleontology.
Preparation required: Pal. 37.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pal. 39. Practical Work in Paleontology.
Preparation required: Pal. 38.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pal. 40. Practical Work in Paleontology.
Preparation required: Pal. 39.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pal. 41. Practical Work in Paleontology.
Preparation required: Pal. 40.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pal. 42. Practical Work in Paleobotany.
Preparation required: Pal. 28.
Freshman Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pal. 43. Practical Work in Paleobotany.
Preparation required: Pal. 42.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pal. 44. Practical Work in Paleobotany.
Preparation required: Pal. 43.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pal. 45. Practical Work in Paleobotany.
Preparation required: Pal. 44.
Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pal. 46. Practical Work in Paleobotany.
Preparation required: Pal. 45.
Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pal. 47. Research Work in Paleontology.
Preparation required: Pal. 24.
Graduate Work, First Semester, 2 to 20 credits.
- Pal. 48. Research Work in Paleontology.
Preparation required: Pal. 47.
Graduate Work, Second Semester, 2 to 20 credits.
- Pal. 49. Research Work in Paleobotany.
Preparation required: Pal. 34.
Graduate Work, First Semester, 2 to 20 credits.
- Pal. 50. Research Work in Paleobotany.
Preparation required: Pal. 49.
Graduate Work, Second Semester, 2 to 20 credits.

- Pal. 51. Research Work in Invertebrate Paleontology.
 Preparation required: 225, 227; Geol. 14, 15, 16, 17, 22, 23; Pal. 7, 8, 23, 24.
 Graduate Work, First Semester, 2 to 20 credits.
- Pal. 52. Research Work in Invertebrate Paleontology.
 Preparation required: Pal. 51.
 Graduate Work, Second Semester, 2 to 20 credits.
- Pal. 53. Research Work in Vertebrate Paleontology.
 Preparation required: 225, 227; Geol. 14, 15, 16, 17, 22, 23; Pal. 6, 7, 23, 24.
 Graduate Work, First Semester, 2 to 20 credits.
- Pal. 54. Research Work in Vertebrate Paleontology.
 Preparation required: Pal. 53.
 Graduate Work, Second Semester, 2 to 20 credits.
- Pal. 55. Research Work upon the Paleozoic Flora.
 Preparation required: 225, 226; Geol. 14, 15, 22, 23; Pal. 15, 16, 33, 34.
 Graduate Work, First Semester, 2 to 20 credits.
- Pal. 56. Research Work on the Paleozoic Flora.
 Preparation required: Pal. 55.
 Graduate Work, Second Semester, 2 to 20 credits.
- Pal. 57. Research Work on the Mesozoic and Cenozoic Flora.
 Preparation required: 225, 226; Geol. 16, 17, 22, 23; Pal. 15, 16.
 Graduate Work, First Semester, 2 to 20 credits.
- Pal. 58. Research Work on the Mesozoic and Cenozoic Flora.
 Preparation required: Pal. 57.
 Graduate Work, Second Semester, 2 to 20 credits.
- Pal. 59. Research Work on Pennsylvania Paleontology.
 Preparation required: 225, 227; Geol. 14, 15, 16, 17, 22, 23; Pal. 7, 8, 23, 24.
 Graduate Work, First Semester, 2 to 20 credits.
- Pal. 60. Research Work on Pennsylvania Paleontology.
 Preparation required: Pal. 59.
 Graduate Work, Second Semester, 2 to 20 credits.
- Pal. 61. Research Work on Pennsylvania Paleobotany.
 Preparation required: 225, 226; Geol. 14, 15, 16, 17, 22, 23; Pal. 15, 16, 33, 34.
 Graduate Work, First Semester, 2 to 20 credits.
- Pal. 62. Research Work on Pennsylvania Paleobotany.
 Preparation required: Pal. 61.
 Graduate Work, First Semester, 2 to 20 credits.
- Pal. 63. Paleontological Education.
 Preparation required: Pal. 1, 2, 3, 4, 5, 6, 7, 8, 17, 18, 19, 20, 21, 22, 23, 24, 37, 38, 39.
 Graduate Work, First Semester, 2 to 20 credits.

Pal. 64. Paleontological Education.

Preparation required: Pal. 63

Graduate Work, Second Semester, 2 to 20 credits.

Pal. 65. History of Paleontology.

Preparation required: Pal. 1, 2, 3, 4, 5, 6, 7, 8, 17, 18, 19, 20, 21, 22, 23, 24, 37, 38, 39.

Graduate Work, First Semester, 2 to 20 credits.

Pal. 66. History of Paleontology.

Preparation required: Pal. 65.

Graduate Work, Second Semester, 2 to 20 credits.

Pal. 67. Paleobotanical Education.

Preparation required: Pal. 9, 10, 11, 12, 13, 14, 15, 16, 27, 28, 29, 30, 31, 32, 33, 34, 42, 43, 44.

Graduate Work, First Semester, 2 to 20 credits.

Pal. 68. Paleobotanical Education.

Preparation required: Pal. 67.

Graduate Work, Second Semester, 2 to 20 credits.

Pal. 69. History of Paleobotany.

Preparation required: Pal. 9, 10, 11, 12, 13, 14, 15, 16, 27, 28, 29, 30, 31, 32, 33, 34, 42, 43, 44.

Graduate Work, First Semester, 2 to 20 credits.

Pal. 70. History of Paleobotany.

Preparation required: Pal. 69.

Graduate Work, Second Semester, 2 to 20 credits.

XI. PETROGRAPHY

This group is considered here under two heads: (1) Optical and Microscopical Mineralogy and (2) Microscopical Petrography.

OPTICAL AND MICROSCOPICAL MINERALOGY.—Under this head are treated the various optical and other characteristics of minerals as revealed by the microscope. Alterations of minerals are especially studied, owing to their importance in the subject of Mining Geology and Petrography. The lectures given are chiefly devoted to the description and use of the microscope as a simple instrument and as a piece of optical apparatus for the determination of minerals and rocks. This part of the work will comprise the use of the petrographical microscope in common and polarized light, both as a microscope and as a polariscope; the chemical properties of minerals as determined under the microscope; and the distinguishing characters of important rock-forming minerals and their alterations.

These lectures are intended to give a clear and suitable introduction to the subject of Microscopical and Optical Mineralogy, which shall be adapted to the needs of geologists, civil and mining engineers, chemists,

metallurgists, teachers, architects, and others who may need a good working or practical knowledge of the subject.

MICROSCOPICAL PETROGRAPHY.—Under this head instruction is given by means of lectures and laboratory practice upon the microscopical characters of rocks, as revealed in their thin sections. It is based on the earlier instruction in Macroscopical Petrography and in the preceding Optical and Microscopical Mineralogy. It is intended not only to assist the student to name the rocks, but also to enable him to understand better the metamorphism of rocks and the origin and structure of ores and other useful geological deposits.

Pet. 1. Optical and Microscopical Mineralogy.

Preparation required: Min. 1, 2; Geol. 5, 6; M. Geol. 1, 2. Taken with Pet. 9.

Sophomore Year, First Semester, 2 credits.

Pet. 2. Optical and Microscopical Mineralogy.

Preparation required: Pet. 1, 9. Taken with Pet. 10.

Sophomore Year, Second Semester, 2 credits.

Pet. 3. Microscopical Petrography.

Preparation required: Pet. 1, 2, 9, 10, 12. Taken with Pet. 11.

Junior Year, First Semester, 2 credits.

Pet. 4. Microscopical Petrography.

Preparation required: Pet. 3, 11. Taken with Pet. 12.

Junior Year, Second Semester, 2 credits.

Pet. 5. Origin of Minerals, Rocks, and Ore Deposits—their Alterations, Relations, and Classifications.

Preparation required: Geol. 9, 11; Pet. 3, 4, 11, 12. Taken with Pet. 13.

Senior Year, First Semester, 2 credits.

Pet. 6. Origin of Minerals, Rocks, and Ore Deposits—their Alterations, Relations, and Classifications.

Preparation required: Pet. 5, 13. Taken with Pet. 14.

Senior Year, Second Semester, 2 credits.

Pet. 7. Research Work in Microscopical Petrography.

Preparation required: Pet. 6, 14.

Graduate Work, First Semester, 2 to 20 credits.

Pet. 8. Research Work in Microscopical Petrography.

Preparation required: Pet. 7, 21.

Graduate Work, Second Semester, 2 to 20 credits.

Pet. 9. Petrographical Laboratory.

Preparation required: Min. 1, 2; Geol. 5, 6; M. Geol. 1, 2. Taken with Pet. 1.

Sophomore Year, First Semester, 2 credits.

Pet. 10. Petrographical Laboratory.

Preparation required: Pet. 9. Taken with Pet. 2.

Sophomore Year, Second Semester, 2 credits.

- Pet. 11. Petrographical Laboratory.
Preparation required: Pet. 10. Taken with Pet. 3.
Junior Year, First Semester, 2 credits.
- Pet. 12. Petrographical Laboratory.
Preparation required: Pet. 11. Taken with Pet. 4.
Junior Year, Second Semester, 2 credits.
- Pet. 13. Petrographical Laboratory.
Preparation required: Pet. 12. Taken with Pet. 5.
Senior Year, First Semester, 2 credits.
- Pet. 14. Petrographical Laboratory.
Preparation required: Pet. 13. Taken with Pet. 6.
Senior Year, Second Semester, 2 credits.
- Pet. 15. Petrographical Laboratory.
Taken with Pet. 9.
Sophomore Year, First Semester, 1 to 12 credits.
- Pet. 16. Petrographical Laboratory.
Taken with Pet. 10.
Sophomore Year, Second Semester, 1 to 12 credits.
- Pet. 17. Petrographical Laboratory.
Taken with Pet. 11.
Junior Year, First Semester, 1 to 12 credits.
- Pet. 18. Petrographical Laboratory.
Taken with Pet. 12.
Junior Year, Second Semester, 1 to 12 credits.
- Pet. 19. Petrographical Laboratory.
Taken with Pet. 13.
Senior Year, First Semester, 1 to 12 credits.
- Pet. 20. Petrographical Laboratory.
Taken with Pet. 14.
Senior Year, Second Semester, 2 credits.
- Pet. 21. Petrographical Laboratory.
Preparation required: Pet. 6, 14. Taken with Pet. 7.
Graduate Work, First Semester, 2 to 20 credits.
- Pet. 22. Petrographical Laboratory.
Preparation required: Pet. 21. Taken with Pet. 8.
Graduate Work, Second Semester, 2 to 20 credits.
- Pet. 23. Practical Work in Petrography.
Preparation required: Pet. 2, 10.
Sophomore Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.
- Pet. 24. Practical Work in Petrography.
Preparation required: Pet. 23.
Junior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Pet. 25. Practtical Work in Petrography.

Preparation required: Pet. 24.

Senior Year, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Pet. 26. Practical Work in Petrography.

Preparation required: Pet. 22.

Graduate Work, Summer Vacation, 4 to 12 weeks, 6 to 18 credits.

Pet. 27. Research Work upon the Petrography of the Coal Measures.

Preparation required: Pet. 6, 14.

Graduate Work, First Semester, 2 to 20 credits.

Pet. 28. Research Work upon the Petrography of the Coal Measures.

Preparation required: Pet. 27.

Graduate Work, Second Semester, 2 to 20 credits.

Pet. 29. Research Work upon the Petrography of Pennsylvania.

Preparation required: Pet. 5, 6, 13, 14.

Graduate Work, First Semester, 2 to 20 credits.

Pet. 30. Research Work upon the Petrography of Pennsylvania.

Preparation required: Pet. 29.

Graduate Work, Second Semester, 2 to 20 credits.

Pet. 31. Research Work upon the Petrography of the United States.

Preparation required: Pet. 5, 6, 13, 14.

Graduate Work, First Semester, 2 to 20 credits.

Pet. 32. Research Work upon the Petrography of the United States.

Preparation required: Pet. 33.

Graduate Work, Second Semester, 2 to 20 credits.

Pet. 33. Research Work in Optical and Microscopical Mineralogy.

Preparation required: Pet. 5, 6, 13, 14.

Graduate Work, First Semester, 2 to 20 credits.

Pet. 34. Research Work in Optical and Microscopical Mineralogy.

Preparation required: Pet. 33.

Graduate Work, Second Semester, 2 to 20 credits.

Pet. 35. Petrographical Education.

Preparation required: Pet. 1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 23, 24.

Graduate Work, First Semester, 2 to 20 credits.

Pet. 36. Petrographical Education.

Preparation required: Pet. 35.

Graduate Work, Second Semester, 2 to 20 credits.

Pet. 37. History of Petrography.

Preparation required: Pet. 1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 14, 23, 24.

Graduate Work, First Semester, 2 to 20 credits.

Pet. 38. History of Petrography.

Preparation required: Pet. 37.

Graduate Work, Second Semester, 2 to 20 credits.

ORGANIZATION

In the reorganization the School has been placed on a broad and liberal plan worthy of a University and in a University spirit. The School of Mines is considered a professional school and co-ordinate with a School of Law, Medicine, or Theology. Like them it is to set its face towards attaining its proper position as a graduate school—a school for mature men and not for boys. The profession of a Mining or Metallurgical or Ceramic or Geological Engineer or Mining Geologist needs as high and broad a training as does any other profession, and no man should enter upon this course until he has obtained a thorough preliminary education.

In the reorganization the work is outlined approximately as it should be to be commensurate with the great industries it represents. In all such work it is a case of demand and supply. If there is a sufficient number of students demanding instruction in any subject, the call will be met. The city of Pittsburgh is the center of one of the greatest industrial regions of the world and there are men on every side who are qualified to answer any call that may be made.

Even with the very limited staff of this year every request for instruction has been met, although the school is four times the size that it was last year and it has been obliged to provide for several graduate students when none were looked for.

Since this is the first year of the reorganization the present small staff, with the instructors belonging to the other schools of the University, has answered, but it is expected to add to the instructional force in the School of Mines from time to time, as the demand and work shall increase. Naturally the development is expected to be from the Freshman Class upwards.

It is believed now that the first demands and appointments will be along some of the various lines in Mining, Coal Mining, and Mining Engineering; Iron and Steel Metallurgy and Non-Ferrous Metallurgy; Inorganic and Organic Geology; Ore Dressing and Coal Washing; Mining Economics and Law; and Ceramics and Ceramic Chemistry.

Twenty-two years ago the Dean reorganized a school of mines, in a town of 2,000 inhabitants, with two assistants. The school was of a far more limited scope and in a narrower field than this one and it had to draw its students almost exclusively from foreign sources. It was left in twelve years with a staff of twenty-seven, and it now has one of nearly fifty. What are the possibilities in a city of over 600,000 inhabitants and with a population of over 2,500,000 almost at its doors—in a state whose mineral wealth is over three times as great as that of any other state in this great nation, whose mineral production leads all other nations and has already doubled in five years?

The School of Mines must face the task that is before it and it must do all that has been outlined, and even far more, or it will fail in its duty to the City, the State, and the Nation.

REQUIREMENTS FOR ADMISSION

All candidates for admission to the School of Mines must be at least seventeen years of age and furnish testimonials of good moral character. Those coming from other colleges must present certificates of a regular dismission.

METHODS OF ADMISSION

Admission is by one of the following methods:

1. By examination. Examinations are held at the University, beginning at 9 o'clock in the morning on the two days following the Commencement in June, and on the two days preceding the opening of the College year in September. For 1909 these fall on June 10 and 11 and Sept. 14 and 15. Certificates for the College Entrance Examination Board of the Middle States and Maryland are accepted in lieu of an entrance examination at the University.

2. By certificates from accredited schools. Instead of examination, certificates from high schools and academies whose work has been approved by the University and whose courses prepare for the Freshman class will be accepted. The official blank certificate provided by the University must be used. It may be obtained by application from the Registrar.

3. By dismission from other colleges. Students from colleges offering equivalent courses will be given provisional credit for the work done and admitted to advanced standing without examination. If their work proves satisfactory, the provisional credits are made permanent.

4. Students showing satisfactory evidence of ability, but who are not candidates for a degree, may be admitted to take such work as they are prepared for. This provision is especially intended for persons of mature age and who have had practical experience.

SUBJECTS OF EXAMINATION

For admission to the School of Mines the student who is a candidate for a degree must offer fifteen units. The unit is the equivalent of four or five recitations of one hour every week for the School year. It is intended to raise these requirements as rapidly as it is practicable, by requiring one unit in Chemistry for all regular students entering the School of Mines in 1910; one unit in Trigonometry for those entering in 1911; one unit in Zoology for those entering in 1912; and one-half unit each in Astronomy and Botany for those entering in 1913.

The units are as follows:

English, 3 units.

Plane and Solid Geometry, 2 units.

Algebra (to Theory of Equations), 2 units.

History and Civil Government, 1 unit.

French or German or Spanish or Italian or Latin or Greek, 2 units.

Physics, 1 unit.

Four units to be selected from the following:

History, 1 or 2 units.

French or German or Spanish or Italian or Latin or Greek, 1 or 2 units.

Chemistry, $1/2$ or 1 unit.

Astronomy, $1/2$ or 1 unit.

Botany, $1/2$ or 1 unit.

Zoology, $1/2$ or 1 unit.

Drawing, $1/2$ or 1 unit.

Shop Work, $1/2$ or 1 unit.

ENGLISH

I. ENGLISH COMPOSITION AND LITERATURE

On his English preparation the future work and success of the student greatly depends, and he cannot have too much nor too thorough a training in it.

1. Three units. The preparation should include the following subjects:

(a) GRAMMAR.—It is expected that the applicant will be familiar with the essentials of English grammar, and will be able to explain the construction of sentences that occur in the literature he has read.

(b) COMPOSITION AND RHETORIC.—The student should know the elementary principles of rhetoric, and should be able to apply them in the construction of sentences and paragraphs, and in the planning of essays. The examination is chiefly practical and involves the ability to write good English.

No student will be accepted whose paper is notably deficient in logical development of the subject, or in such details of form as spelling, punctuation, grammar, and division into paragraphs.

(c) LITERATURE.—The books recommended are the Uniform College Entrance requirements in English. Other similar works will be accepted as equivalents.

The candidate is required to write one or more paragraphs on each of several subjects chosen from a considerably larger number given in the examination paper. The questions on all

the books assume a knowledge of subject-matter and structure, but those on the books prescribed for study and practice call for more detailed treatment than those on books prescribed for reading.

A.—The books prescribed for reading and practice are:

In 1909, 1910, and 1911:—

Group I (Two to be selected).

Shakespeare's *As You Like It*, *Henry V.*, *Julius Caesar*, *Merchant of Venice*, *Twelfth Night*.

Group II (One to be selected).

Bacon's *Essays*; Bunyan's *Pilgrim's Progress*, part I; Steele and Addison's *Sir Roger de Coverley Papers*; Franklin's *Autobiography*.

Group III (One to be selected).

Chaucer's *Prologue to the Canterbury Tales*; Spenser's *Faerie Queene*, selections; Pope's *Rape of the Lock*; Goldsmith's *Deserted Village*; Palgrave's *Golden Treasury* (first series), Books II, and III, with special attention to Dryden, Collins, Gray, Cowper, Burns.

Group IV (Two to be selected).

Goldsmith's *Vicar of Wakefield*; Scott's *Ivanhoe* and *Quentin Durward*; Hawthorne's *House of Seven Gables*; Thackeray's *Henry Esmond*; Mrs. Gaskell's *Cranford*; Dickens' *Tale of Two Cities*; George Eliot's *Silas Marner*; Blackmore's *Lorna Doone*.

Group V (Two to be selected).

Irving's *Sketch Book*; Lamb's *Essays of Elia*; De Quincey's *Joan of Arc*, and *The English Mail-Coach*; Carlyle's *Heroes and Hero Worship*; Emerson's *Essays*, selections; Ruskin's *Sesame and Lilies*.

Group VI (Two to be selected).

Coleridge's *Ancient Mariner*; Scott's *Lady of the Lake*; Byron's *Mazeppa*, and *The Prisoner of Chillon*; Palgrave's *Golden Treasury* (first series), Book IV, with special attention to Wordsworth, Keats, and Shelley; Macaulay's *Lays of Ancient Rome*; Poe's *Poems*; Lowell's *Vision of Sir Launfal*; Arnold's *Sohrab and Rustum*; Longfellow's *The Courtship of Miles Standish*; Tennyson's *Gareth and Lynette*, *Lancelot and Elaine*, *The Passing of Arthur*; Browning's *Cavalier Tunes*, *The Lost Leader*, *How They Brought the Good News*, *Evelyn Hope*, *Home Thoughts from Abroad*, *Home Thoughts from the Sea*, *Incident of the French Camp*, *The Boy and the Angel*, *One Word More*, *Herve Riel*, *Pheidippides*.

B.—The books prescribed for study and practice are:

In 1909, 1910, and 1911: Shakespeare's *Macbeth*; Milton's *Lycidas*, *Comus*, *L'Allegro*, and *Il Penseroso*; Burke's *Speech on Conciliation with America*, or Washington's *Farewell Address*, and Webster's *First*

Bunker Hill Oration; Macaulay's Life of Johnson, or Carlyle's Essay on Burns.

Applicants who are not graduates of accredited High Schools, or who have not passed the Uniform Entrance examinations, will be required to present themselves for the University of Pittsburgh Entrance examinations, held the two days preceding the opening of the first semester.

2. Four units. Advanced standing in English may be given to the graduates of those High Schools that have exceptionally strong and thorough courses in English throughout the entire four years. This calls for additional work in literature, and especially a thorough knowledge of the elementary principles of rhetoric, and the ability to write good English.

LANGUAGES

Two years of either French or German or Spanish or Italian, or Latin or Greek are required. The student should know the grammar thoroughly, be able to pronounce well, and translate at sight ordinary prose. In German the reading should be the equivalent of Storm's *Immensee*; Baumbach's *Die Nonna*; Heyse's *L'Arrabbiata*; Hillern's *Hocher als die Kirche*; Heyse's *Das Maedchen von Treppi*; Gerstaecker's *Germelshausen*; Seidel's *Maerchen*.

In French the reading should be the equivalent of Bigarreau, *Le Duc de Beaufort*; Gautier, *L'Abbe Constantin*; Fenelon, *Telemaque*; Le Barbier de Seville; Victor Hugo, *Hernani*.

MATHEMATICS

1. Arithmetic, including the Metric System.
2. Algebra to Theory of Equations, including all subjects found in standard text-books to this point.
3. Plane and Solid Geometry.

The attention of those intending to become students, as well as that of their instructors, is especially directed to the entrance requirements for admission in Mathematics. Experience has shown that not all who have gone over the subjects have become expert in practice to the degree necessary for the rapid accomplishment of work, and numerous failures result from inability to keep up the necessary pace. Prolonged and persistent practice in the application of mathematical principles should be the rule that accuracy, certainty, and speed may be attained before the higher operations are undertaken. Especially necessary is a thorough, working review of Algebra, which no one intending to matriculate in this School can afford to do without.

Next to English the work of the student depends upon his knowledge of Mathematics. All who can are advised to obtain a thorough knowledge of Trigonometry and Higher Algebra before entrance.

HISTORY

American History, as found in any approved text-book in use in the secondary schools, is accepted. Elements of Civil Government should be studied, as well as Ancient, Mediæval, and Modern History, as found in Myers' or other text-books of the same general character.

SCIENCE

Preparation in Science, outside of Physics, should cover a period of at least one year. It is recommended that the subject offered shall be one year or more of Chemistry, or Zoology, or Botany. It is important that the student at the first shall have a general knowledge of elementary Chemistry, Botany, Zoology, and Astronomy, as much of the work of the Freshman year is based upon those subjects.

The student should have a thorough acquaintance with the principles of Physics and be able to apply them. The works of Crew, Ames, Millikan and Gale or any other similar standard work of recent date will indicate the amount of ground that should be covered.

Other general information applying to the School of Mines, as well as to the College and the Engineering School, will be found in Parts II. and III. of the University Catalog.

SCHOLARSHIPS

Through the liberality of friends of the University five scholarships are offered in the School of Mines. These scholarships entitle the holder to free tuition, and are to be awarded to the sons of men engaged in mining. One of these scholarships is limited to residents of Allegheny County; the others are available to those residing in Western Pennsylvania.

One scholarship for any intending students of the University is available for each senatorial district in the State, the selection to be made by the State Senator for each district.

Information in regard to these scholarships may be obtained from the Secretary of the University.

REQUIREMENTS FOR DEGREES

For all degrees for students entering the Freshman class in the School of Mines, in 1908 and subsequently, one hundred and eighty-four (184) *credits* are required. The degrees available in the School of Mines are Bachelor of Science and Engineering Degrees.

In addition, every candidate must prepare and present to the Dean of the School, at least ten days before Commencement, a satisfactory thesis. The thesis is to be upon some subject pertaining to the course and done under the direction of an instructor in that subject. The thesis must bear upon it the written approval of the instructor, under whose direction the work was done, before it can be accepted.

In the School of Mines each *credit* is considered to be one hour of recitation or quiz, or three hours of laboratory or field work each week.

In the College and the Engineering School one hour of recitation, or two hours in laboratory, drawing room, or gymnasium, or three hours in the shops, count as a single credit.

In lectures the credits vary according to the purpose of the lecture. A lecture given for explanatory or illustrative purposes is classed as a laboratory hour; but one upon which a recitation or quiz is based is considered as a recitation hour.

All candidates for any degree in the School of Mines are required to present credits in the following subjects—the figure in parenthesis following the subject number or abbreviation indicating the credits belonging to that subject: 169 (3); 172 (3); 185 (5); 194 (1); 370 (2); 371 (2); Min. 1, 2, (12); Geol. 5, 6, (4); Met. 1, (2); M. Geol. 1, 2, (4); Ore. 1, (2); Mine. 1, 2, (4). Total 44 credits.

In addition to the above 44 credits each candidate for the *Bachelor of Science Degree* in any group or subject must also elect work giving him at least 30 credits more in that group exclusive of the summer vacation work. This leaves him 110 credits for use in obtaining such a broad and general training as he may need, which will vary according to his previous education and circumstances. The Bachelor of Science Degree is given in the following groups or subjects: Ceramics, Cements, Inorganic Geology, Organic Geology, Metallurgy, Electro-Metallurgy, Hydro-Metallurgy, Assaying, Mineralogy, Mining, Coal Mining, Mining Geology, Mining Law, Ore Dressing, Paleontology, Paleobotany, and Petrography.

In the case of Mining Law, allied work in Law, Economics, Psychology, Sociology, etc., will be accepted for part of the 30 credits.

All courses and subjects taken must receive the approval of the Dean before they will be accepted for a degree in any special group.

Candidates for an *Engineering Degree* must not only complete all the required work of the Bachelor of Science Degree, in addition to the 30 group credits, but also obtain credit in the following subjects: 166, (3); 174, (4); 175, (6); 176, (4); 285, (4); 286, (3), or 24 credits. This leaves 88 credits to be selected from the electives.

The Engineering Degrees given are Ceramic Engineer (Cer. E.), Geological Engineer (G. E.), Metallurgical Engineer (Met. E.), and Mining Engineer (E. M.).

ELECTIVES OR OPTIONS

In many of the electives and in much of the required work there is no reason why one study should be taken in one year instead of in another, except when necessary to preserve the sequence. Many Freshman, Sophomore, and Junior studies in this School are Senior or Graduate studies in other institutions and even in other Schools in this University—the position being largely due to the particular conditions in each case. A student must elect his studies in sequence, but he is not necessarily confined to taking them in any particular year, if he can obtain the consent of the instructors concerned and of the Dean. In the same way a study belonging to a subsequent year, or even a graduate year, can be taken by any properly prepared student in an earlier year.

In special cases, particularly in the advanced subjects, and in the laboratory work, more hours can be taken than those specified in the catalogue, by means of a petition and the consent of the instructor and Dean.

Changes in hours or subjects will be made from time to time to meet the changes in the courses in other Schools in the University or the needs of this School.

Certain of the electives or options announced are naturally to be given every year, others are given only every other year or every third or fourth year as needed; still others are only given when asked for by a sufficient number of students. All students desiring to take up elective work should write to the Dean concerning it, so they can be informed whether the work in question will be given or not.

VACATION CREDITS

In order to enable the student to become better fitted for his future practice, he is allowed to substitute each year for his elective work from 4 to 12 weeks' work of a specified kind during his summer vacation, giving him from 6 to 18 credits, if he desires to do so. In order to substitute, the student must first arrange with the Dean of the School and the instructor who has charge of the subject, the details of the work, the company, and the location. In order to avoid mistakes this must be done in writing and the records kept on file. When the work has been completed, the student is further to present from the company for which he has worked a certificate stating the kind, character, and grade of work done and time spent. The student must also present a written thesis giving in detail an account of the work he has done and its principles, and then pass a written or oral examination upon the work and the principles involved.

DEGREES

FOR STUDENTS ENROLLED IN THE SCHOOL OF MINES
PRIOR TO COMMENCEMENT 1908 OR ENTERING WITH
ADVANCED STANDING ANY OF THE THEN
UPPER CLASSES

In the reorganization of the School of Mines it is a somewhat difficult proposition to conserve the interests and courses as formerly arranged and introduce the new work without too much duplication. It is thought that the following arrangement will serve the purpose and allow the introduction of the new work in natural sequence, and as required, commencing with the Freshman Class entering in September, 1908.

1. The class graduating in 1909 with the Degree of Mining Engineer will take: 61, (2); 306, (3); Met. 15, 68, (4); Ore. 1, (2); Mine. 9, 10, (4); or their equivalents making a total of 15 credits in required work and 21 credits in electives for the Senior Year, besides completing the equivalent of the first three years of the course for the School of Mines published in the Catalog for 1906-1907. Should any wish to graduate with the Bachelor of Science Degree a special course will be arranged.

2. The class graduating in 1910 with the degree of Engineer of Mines, will take: 285, (4); 286, (3); Min. 1, (6); Met. 1, (2); Geol. 5, 6, (4); M. Geol. 1, 2, (4); Ore. 1, (2); Mine. 1, 2, (4); or their equivalents making a total of 29 credits in required work and 43 credits in elective subjects for the Junior and Senior Years.

3. The class graduating in 1910 with the degree of Bachelor of Science, will take: Min. 1, (6); Met. 1, (2); Geol. 5, 6, (4); M. Geol. 1, 2, (4); Ore. 1, (2); Mine. 1, 2, (4); or a total of 22 credits in required subjects and 50 credits in elective subjects for the Junior and Senior Years.

4. The class graduating in 1911, with the degree of Engineer of Mines, will take: 175, (6); 176, (4); 285, (4); 286, (3); Min. 1, 2, (12); Met. 1, (2); Geol. 5, 6, (4); M. Geol. 1, 2, (4); Ore. 1, (2); Mine. 1, 2, (4); or a total of 45 credits in required subjects and 63 credits in elective subjects for the Sophomore, Junior, and Senior Years.

5. The class graduating in 1911, with the degree of Bachelor of Science, will take: Min. 1, 2, (12); Met. 1, (2); Geol. 5, 6, (4); M. Geol. 1, 2, (4); Ore. 1, (2); Mine. 1, 2; or 28 credits in required subjects and 80 credits in elective subjects.

The statements given earlier cover the questions relating to laboratory hours, electives, thesis, etc. The student is to select his electives from the work current at that time. The number of students necessary to cause an elective to be given will vary according to circumstances, but in general it may be stated to be at least five.

SHORT COURSES IN MINING

To meet the needs of students of age and experience who desire a mining or metallurgical education, but who are unable to take a complete four years' course, and such others as wish to prepare for the examinations for mine inspectors, foremen, and fire bosses, courses of instruction have been provided covering two years. These courses enable the student to obtain instruction in Crystallography, Mineralogy, Petrography, Paleontology, General and Field Geology, Mining Geology, Mining, Ore Dressing and Coal Washing, Mathematics, Plane and Mine Surveying, General Chemistry, Qualitative and Quantitative Chemical Analysis, Ceramics, Drawing, Designing, Assaying, Metallurgy, Carpentry, Wood Turning, Forging, Pattern Making, Foundry, Machine Tool Work, etc., etc. The requirements for admission to this course are the same as those for the regular four years' course. It is intended to prepare the student for general mining, mining law, metallurgical, assaying, ceramic, paleontological, petrographical, and geological work.

In order to meet the needs of different students and to give some general training, elective work is offered, and a student in one year is allowed to elect any work in the same semester of the other year, or of any year in the four years' courses that he is properly prepared to take. Every student is required to take each semester at least twenty-three periods, including the required work.

The electives need to be selected with care and with reference to the results desired. The Dean and the other instructors are always willing to assist the students in their selections, and every schedule has to be approved by the Dean before it can stand.

A student completing a course will receive a certificate to that effect on his making application to the Registrar of the University.

To complete a two years' Short Course the student must obtain 92 credits. The 92 credits are to comprise: 169, (3); 172, (3); 185, (5); 186, (3); 194, (2); 370, (2); Min. 1, 2, (12); Geol. 5, 6, (4); Met. 1, 68, (4); M. Geol. 1, 2, (4); Ore. 1, (2); Mine. 1, 2, (4); or a total of 48 credits in required work and 44 credits in elective work, of which at least 15 must be in the group in which the student desires to obtain his certificate.

Short Courses can be taken in Ceramics, Cements, Inorganic Geology, Organic Geology, Metallurgy, Assaying, Mineralogy, Mining, Coal Mining, Metal Mining, Mining Geology, Mining Law, Ore Dressing, Paleontology, Paleobotany, Petrography, etc.

SPECIAL STUDENTS

The Special Students in the School of Mines are divided into two classes:

1. *Students taking irregular or special courses* owing to lack of time to take an entire course. They are under the general rules of the School and they are expected to carry a full schedule of work unless exempted for special reasons.

2. *Persons of suitable age and experience in practical work* will be admitted without examination to take such studies as the different instructors shall be satisfied they are qualified to pursue.

Long experience with such students has shown that they make most valuable and energetic workers, and have a very beneficial influence upon the undergraduate students. This division of Special Students is designed for men of an active and practical business life, usually in some department of Mining, Ceramics, Geology, or Metallurgy, who feel the need of further education that will assist them in their future work. Results have demonstrated that such an opportunity as is here afforded has been of distinct and lasting benefit to such students, oftentimes placing them upon a distinctly higher plane in life than otherwise they could have reached.

This work is designed to assist persons into whose hands has come the management of estates connected with mining industries, to whom a certain amount of knowledge of Mining Law, Mining, and allied subjects is not only useful but essential.

In the same way, men engaged in prospecting have found the special study of Mineralogy and Mining Geology invaluable to them.

The School of Mines especially desires to aid all who wish to increase their stock of knowledge in the subjects taught in it, and it will cordially welcome all such special students and give them every opportunity it can.

It is intended in this way to assist those who are preparing to pass examinations for the various positions of mine inspector, mine foreman, fire boss, etc. All persons who are thus interested in mining and allied work are allowed to enter at any time and to take any studies that they are able to master. They are permitted to remain as long as they wish, and are not under the operation of any college rules; but are

expected to conduct themselves as good citizens and to attend to their selected work, or else withdraw from the institution.

The class room work usually commences at the beginning of a semester and continues to its close, but if these students can profit by entering at other times and work can be arranged to meet their needs, there are no objections to this. In the majority of the laboratories the work can commence at any period, and part or the entire time of the student devoted to it as may seem best. Thus one having leisure at certain times of the year can take up different portions of the work in successive years.

The class room work specially available includes General Geology, Mining Geology, Ceramics, Ore Dressing and Preparation of Coal for the Market, Surveying, Mine Surveying, the different branches of Mining, Mine Gases, Explosives, Mine Accounts, Purchases and Supplies, Mining Law and Management, the General Principles of Metallurgy, the Properties and Utilization of Fuels, Refractory Materials and Alloys, the Metallurgy of Iron, Steel, Copper, Lead, Zinc, Nickel, and the Minor Metals, etc., etc.

In the laboratories there will be taught the adjustment, manipulation and use of the transit and other surveying instruments; the practical methods of discriminating and determining minerals, rocks, and fossils; Geological and Mine Surveying; Mapping and Field Geology; methods of Ore Dressing; "laying-out" of mine plants (including tipples, head-frames, shaft houses, mill buildings, fans, bents, chutes, etc.); processes of testing fans, operating drills and other mine machinery; mine gases, etc.; work in fuel testing, including the determination of moisture, volatile hydrocarbons, fixed carbon and ash in coal, or proximate analyses; the determination of sulphur; tests to determine the effect of washing on coals; Gas Analysis, both of furnace and flue gases; the determination of the efficiency of furnaces; Assaying, including the assay of gold, silver, and lead ores and furnace products by all known methods of assaying ores, fluxes, slags, and furnace products; and analyses for iron, copper, lead, zinc, and other substances met with in metallurgical work. Opportunities are also given for carrying out tests on special processes of ore treatment, like the availability of the cyanide process for gold, etc.

All the School's work is freely available for use. No requirements will be made of the practical man who wishes to take advantage of the opportunities beyond that he shall be able to profit by the work that he wishes to take and that he shall attend to it. No matter what has been his past work, or what his age is, if he has the ambition, energy, and perseverance to rise, the School will be only too glad to help him in every way it can.

ADVISORY COURSES

The courses given below are only a few of the numerous equally good ones that could be arranged. They are not required but are simply given to assist the student in wisely selecting his studies so as to have them in sequence; as otherwise he might readily find himself stranded in the latter portion of his course, with few or no studies that he has prepared himself to take.

ENGINEER OF MINES

FRESHMAN YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|------------|--|----------|
| Min. 1 | Crystallography and Mineralogy | 6 |
| Geol. 5 | General Geology | 2 |
| Geol. 47 | Field Geology and Geological Surveying and Mapping | 2 |
| M. Geol. 1 | Mining Geology | 2 |
| 166 | Advanced Algebra | 3 |
| 169 | Trigonometry | 3 |
| 185 | Chemistry | 5 |
| 194 | Chemical Calculations | 1 |
| 370 | Mechanical Drawing | 2 |
| | | <hr/> 26 |

SECOND SEMESTER.

| | | |
|------------|--|----------|
| Min. 2 | Mineralogy and Petrography | 6 |
| Geol. 6 | Structural and Field Geology | 2 |
| Geol. 47 | Field Geology and Geological Surveying and Mapping | 2 |
| M. Geol. 2 | Mining Geology | 2 |
| 172 | Surveying | 3 |
| 174 | Analytic Geometry | 4 |
| 186 | Qualitative Analysis | 3 |
| 194 | Chemical Calculations | 1 |
| 371 | Mechanical Drawing | 2 |
| | | <hr/> 25 |

SOPHOMORE YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|--------|---------------------------|---------|
| Pet. 1 | Microscopical Mineralogy | 2 |
| Pet. 9 | Petrographical Laboratory | 2 |

ADVISORY COURSES

119

| | | |
|------------|--|----|
| M. Sur. 1 | Mine Surveying | 2 |
| Met. 1 | Principles of Metallurgy | 2 |
| Met. 68 | Fire Assaying | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| M. Geol. 3 | Metallites or Non-Metalliferous Deposits | 2 |
| M. Geol. 5 | Metallites or Metalliferous Deposits | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| Mine. 44 | Mining Laboratory and Design | 2 |
| 175 | Calculus | 3 |
| 187 | Quantitative Analysis | 3 |
| | | 26 |

SECOND SEMESTER.

| | | |
|------------|--------------------------------------|----|
| Pet. 2 | Microscopical Mineralogy | 2 |
| Pet. 10 | Petrographical Laboratory | 2 |
| M. Sur. 2 | Mine Surveying | 2 |
| M. Geol. 4 | Building and Ornamental Stones | 2 |
| M. Geol. 6 | Metallites or Metalliferous Deposits | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| Mine. 45 | Mining Laboratory and Design | 2 |
| 175 | Calculus | 3 |
| 176 | Analytic Mechanics | 4 |
| 210 | Quantitative Analysis | 3 |
| | | 24 |

JUNIOR YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|--------------|-----------------------------------|---------|
| Pet. 3 | Microscopical Petrography | 2 |
| Pet. 11 | Petrographical Laboratory | 2 |
| M. Geol. 7 | Ore Deposits of the United States | 2 |
| Mine. 5 or 7 | Coal or Metal Mining | 2 |
| Mine. 9 | Mining Engineering | 2 |
| Mine. 13 | Mine Gases, Ventilation, etc. | 2 |
| Mine. 17 | Mine Management, Accounts, etc. | 2 |
| Mine. 46 | Mining Laboratory and Design | 2 |
| Mine. 65 | Electricity Applied to Mining | 2 |
| Law 1 | Principles of Law and Mining Law | 2 |
| 61 | Economics | 2 |
| 285 | Mechanics of Materials | 2 |
| | | 24 |

SCHOOL OF MINES

SECOND SEMESTER.

| | | |
|--------------|--|----------|
| Pet. 4 | Microscopical Petrography | 2 |
| Pet. 12 | Petrographical Laboratory | 2 |
| M. Geol. 8 | Ore Deposits of the United States | 2 |
| Mine. 6 or 8 | Coal or Metal Mining | 2 |
| Mine. 10 | Mining Engineering | 2 |
| Mine. 14 | Mine, Gases, Ventilation, etc. | 2 |
| Mine. 18 | Mine Management, Accounts, Supplies, Purchases, Sales, etc. | 2 |
| Mine. 47 | Mining Laboratory and Design | 2 |
| Mine. 66 | Electricity Applied to Mining | 2 |
| Law 2 | Mining Law and Mining Injuries | 2 |
| 286 | Hydro-Mechanics and Hydraulics | 3 |
| 289 | Masonry—Construction and Foundations | 2 |
| | | <hr/> 25 |

SENIOR YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|-------------|---|----------|
| Pet. 5 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 13 | Petrographical Laboratory | 2 |
| M. Geol. 36 | Genesis of Ore Deposits | 2 |
| Mine. 11 | Mining Engineering | 2 |
| Mine. 15 | Laying out of Mines and Mine Plants | 2 |
| Mine. 29 | Mine Prospecting, Sampling, etc. | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, etc. | 2 |
| Mine. 48 | Mine Laboratory and Design | 2 |
| 292 | Railroad Engineering—Location | 3 |
| 306 | Engines and Boilers | 3 |
| 320a | Engine and Boiler Testing | 1 |
| | | <hr/> 25 |

SECOND SEMESTER.

| | | |
|-------------|---|---|
| Pet. 6 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 14 | Petrographical Laboratory | 2 |
| M. Geol. 37 | Genesis of Ore Deposits | 2 |
| Mine. 12 | Mining Engineering | 2 |
| Mine. 16 | Laying out of Mines and Mine Plants | 2 |
| Mine. 30 | Mines Accidents—Causes, Prevention, etc. | 2 |
| Mine. 34 | Mine Labor, Strikes, Legislation, etc. | 2 |
| Mine. 49 | Mining Laboratory and Design | 2 |
| 69 | Business Law | 2 |

ADVISORY COURSES

121

| | | |
|------|-----------------------------------|-------|
| 292a | Railroad Engineering—Construction | 2 |
| 294 | Roads and Pavements | 2 |
| 297 | Contracts and Specifications | 2 |
| | | <hr/> |
| | | 24 |

METALLURGICAL ENGINEER

FRESHMAN YEAR

Same as that for Mining Engineer Degree.

SOPHOMORE YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|---------|--------------------------------------|---------|
| Met. 1 | Principles of Metallurgy | 2 |
| Met. 2 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 4 | Furnaces, Refractory Materials, etc. | 2 |
| Met. 13 | Metallography | 2 |
| Met. 40 | Metallurgical Laboratory | 2 |
| Met. 68 | Fire Assaying | 2 |
| Met. 74 | Wet Assaying | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| 175 | Calculus | 3 |
| 187 | Quantitative Analysis | 3 |
| | | <hr/> |
| | | 24 |

SECOND SEMESTER.

| | | |
|---------|--------------------------------------|-------|
| Met. 3 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 5 | Furnaces, Refractory Materials, etc. | 2 |
| Met. 6 | Alloys, etc. | 2 |
| Met. 14 | Metallography | 2 |
| Met. 41 | Metallurgical Laboratory | 2 |
| Met. 69 | Fire Assaying | 2 |
| Met. 75 | Wet Assaying | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| 175 | Calculus | 3 |
| 176 | Analytic Mechanics | 4 |
| 187 | Quantitative Analysis | 3 |
| | | <hr/> |
| | | 26 |

SCHOOL OF MINES

JUNIOR YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|----------|--|----------|
| Met. 15 | Metallurgy of Iron, Foundry Work, etc. | 2 |
| Met. 19 | Metallurgy of Gold and Silver | 2 |
| Met. 28 | Hydro-Metallurgy | 2 |
| Met. 32 | Electro-Metallurgical Processes | 2 |
| Met. 36 | Metallurgical Designing | 2 |
| Met. 42 | Metallurgical Laboratory | 2 |
| Met. 76 | Wet Assaying | 2 |
| Met. 115 | Coke, its Manufacture, Properties, Uses, etc. | 2 |
| Mine. 17 | Mine Management, Accounts, Supplies, Purchases, Sales, etc. | 2 |
| 60 | Political Economy | 3 |
| 285 | Mechanics of Materials | 2 |
| | | <hr/> 23 |

SECOND SEMESTER.

| | | |
|----------|--|----------|
| Met. 16 | Metallurgy of Iron, Foundry Work, etc. | 2 |
| Met. 20 | Metallurgy of Gold and Silver | 2 |
| Met. 29 | Hydro-Metallurgy | 2 |
| Met. 33 | Electro-Metallurgical Processes | 2 |
| Met. 37 | Metallurgical Designing | 2 |
| Met. 43 | Metallurgical Laboratory | 2 |
| Met. 77 | Wet Assaying | 2 |
| Mine. 18 | Mine Management, Accounts, Supplies, Purchases, Sales, etc. | 2 |
| 60 | Political Economy | 3 |
| 286 | Hydro-Mechanics and Hydraulics | 3 |
| 289 | Masonry—Construction and Foundations | 2 |
| | | <hr/> 24 |

SENIOR YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|---------|--------------------------------|---------|
| Met. 17 | The Metallurgy of Steel | 2 |
| Met. 21 | The Metallurgy of Copper | 2 |
| Met. 23 | The Metallurgy of Lead | 2 |
| Met. 25 | The Metallurgy of Zinc | 2 |
| Met. 26 | The Metallurgy of Minor Metals | 2 |
| Met. 30 | Hydro-Metallurgy | 2 |

ADVISORY COURSES

123

| | | |
|----------|--|----------|
| Met. 34 | Electro-Metallurgy | 2 |
| Met. 38 | Metallurgical Designing | 2 |
| Met. 44 | Metallurgical Laboratory | 2 |
| Met. 78 | Wet Assaying | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, etc. | 2 |
| | | <hr/> 24 |

SECOND SEMESTER.

| | | |
|----------|--|----------|
| Met. 18 | The Metallurgy of Steel | 2 |
| Met. 22 | The Metallurgy of Copper | 2 |
| Met. 24 | The Metallurgy of Lead | 2 |
| Met. 27 | The Metallurgy of the Minor Metals | 2 |
| Met. 31 | Hydro-Metallurgy | 2 |
| Met. 35 | Electro-Metallurgy | 2 |
| Met. 39 | Metallurgical Designing | 2 |
| Met. 45 | Metallurgical Laboratory | 2 |
| Met. 79 | Wet Assaying | 2 |
| Mine. 30 | Mine Accidents, Causes, etc. | 2 |
| Mine. 34 | Mine Labor, Strikes, Legislation, etc. | 2 |
| 297 | Contracts and Specifications | 2 |
| | | <hr/> 24 |

CERAMIC ENGINEER

FRESHMAN YEAR

Same as the Mining Engineer.

SOPHOMORE YEAR

FIRST SEMESTER.

| | | |
|------------|---|----------|
| Pet. 1 | Microscopical Mineralogy | 2 |
| Pet. 9 | Petrographical Laboratory | 2 |
| M. Sur. 1 | Mine Surveying | 2 |
| Met. 1 | Principles of Metallurgy | 2 |
| M. Geol. 3 | Metalliferous or Non-Metalliferous Deposits | 2 |
| M. Geol. 9 | Clays—Their Origin, Occurrence, etc. | 2 |
| Cer. 1 | Clay Testing | 2 |
| Cer. 3 | Bricks, Tiles, Terra Cotta, etc. | 2 |
| Cer. 21 | Ceramic Laboratory | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| 175 | Calculus | 3 |
| 187 | Quantitative Analysis | 3 |
| | | <hr/> 26 |

SCHOOL OF MINES

SECOND SEMESTER.

| | | |
|-------------|--------------------------------------|----------|
| Pet. 2 | Microscopical Mineralogy | 2 |
| Pet. 10 | Petrographical Laboratory | 2 |
| M. Geol. 10 | Clays—Their Origin, Occurrence, etc. | 2 |
| M. Geol. 13 | Material for Glazes, etc. | 2 |
| Cer. 2 | Clay Mining and Manufacture | 2 |
| Cer. 4 | Bricks, Tiles, Terra Cotta, etc. | 2 |
| Cer. 21 | Ceramic Laboratory | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| 175 | Calculus | 3 |
| 176 | Analytic Mechanics | 4 |
| 187 | Quantitative Analysis | 3 |
| | | <hr/> 26 |

JUNIOR YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|-------------|-------------------------------------|----------|
| Pet. 3 | Microscopical Petrography | 2 |
| Pet. 11 | Petrographical Laboratory | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| M. Geol. 11 | Lime, Plaster, and Cement Materials | 2 |
| Cer. 5 | Limes, Plasters, and Cements | 2 |
| Cer. 7 | Glazes, Enamels, and Colors | 2 |
| Cer. 9 | Manufacture of Glass, etc. | 2 |
| Cer. 11 | Ceramic Calculations | 2 |
| Cer. 13 | Cements—Their Manufacture, etc. | 2 |
| Cer. 17 | Fire Brick—Manufacture, etc. | 2 |
| Cer. 29 | Ceramic Laboratory | 2 |
| Law 1 | Principles of Law and Mining Law | 2 |
| 285 | Mechanics of Materials | 2 |
| | | <hr/> 26 |

SECOND SEMESTER.

| | | |
|-------------|--------------------------------------|---|
| Pet. 4 | Microscopical Petrography | 2 |
| Pet. 12 | Petrographical Laboratory | 2 |
| M. Geol. 11 | Lime, Plaster, and Cement Materials | 2 |
| Cer. 5 | Limes, Plasters, and Cements | 2 |
| Cer. 8 | Glazes, Enamels, and Colors | 2 |
| Cer. 10 | Manufacture of Glass | 2 |
| Cer. 14 | Ceramic Laboratory | 2 |
| Cer. 18 | Manufacture of Sand-Lime-Brick, etc. | 2 |

ADVISORY COURSES

125

| | | |
|---------|--------------------------------------|-------|
| Cer. 30 | Ceramic Laboratory | 2 |
| Law 2 | Mining Law and Mining Injuries | 2 |
| 286 | Hydro-Mechanics and Hydraulics | 3 |
| 289 | Masonry—Construction and Foundations | 2 |
| | | <hr/> |
| | | 25 |

SENIOR YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|----------|--|---------|
| Met. 2 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 4 | Furnaces, Refractory Materials, etc. | 2 |
| Cer. 12 | Cements—Their Manufacture, Uses, etc. | 2 |
| Cer. 15 | Concrete—Its Properties, Uses, etc. | 2 |
| Cer. 19 | Manufacture of Pottery and Porcelain | 2 |
| Cer. 25 | Ceramic Laboratory | 2 |
| Mine. 17 | Mine Management, Accounts, Supplies, etc. | 2 |
| Mine. 29 | Mine Prospecting, Sampling, Valuation, etc. | 2 |
| Mine. 31 | Mine Explosives, Care and Use | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, Care, etc. | 2 |
| 61 | Economics | 2 |
| | | <hr/> |
| | | 24 |

SECOND SEMESTER.

| | | |
|----------|---|-------|
| Met. 3 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 5 | Furnaces, Refractory Materials, etc. | 2 |
| Cer. 14 | Cements—Their Manufacture, Uses, etc. | 2 |
| Cer. 16 | Concrete Construction | 2 |
| Cer. 20 | Manufacture of Pottery and Porcelain | 2 |
| Cer. 26 | Ceramic Laboratory | 2 |
| Mine. 30 | Mine Accidents—Causes, Prevention, etc. | 2 |
| Mine. 31 | Mine Explosives—Care and Use | 2 |
| Mine. 34 | Mine Labor, Strikes, Legislation, etc. | 2 |
| 76 | Ethics | 2 |
| 69 | Business Law | 2 |
| 297 | Contracts and Specifications | 2 |
| | | <hr/> |
| | | 24 |

GEOLOGICAL ENGINEER

FRESHMAN YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|------------|--|----------|
| Min. 1 | Crystallography and Mineralogy | 6 |
| Geol. 5 | General Geology | 2 |
| Geol. 47 | Field Geology and Geological Surveying and Mapping | 2 |
| M. Geol. 1 | Mining Geology | 2 |
| 166 | Advanced Algebra | 3 |
| 169 | Trigonometry | 3 |
| 185 | Chemistry | 5 |
| 194 | Chemical Calculations | 1 |
| 370 | Mechanical Drawing | 2 |
| | | <hr/> 26 |

SECOND SEMESTER.

| | | |
|------------|--|---|
| Min. 2 | Mineralogy and Petrography | 6 |
| Geol. 6 | Structural and Field Geology | 2 |
| Geol. 48 | Field Geology and Geological Surveying, etc. | 2 |
| M. Geol. 2 | Mining Geology | 2 |
| 172 | Surveying | 3 |
| 174 | Analytic Geometry | 4 |
| 186 | Qualitative Analysis | 3 |
| 194 | Chemical Calculations | 1 |
| 371 | Mechanical Drawing | 2 |

25

SOPHOMORE YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|--|---------|
| Pet. 1 | Microscopical Mineralogy | 2 |
| Pet. 9 | Petrographical Laboratory | 2 |
| M. Sur. 1 | Mine Surveying | 2 |
| Met. 1 | Principles of Metallurgy | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| Geol. 7 | Biological Geology | 2 |
| Geol. 9 | Physical and Chemical Geology | 2 |
| Geol. 14 | Paleozoic Geology | 2 |
| M. Geol. 3 | Metallites or Non-Metalliferous Deposits | 2 |
| M. Geol. 5 | Metallites or Metalliferous Deposits | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| 175 | Calculus | 3 |

25

ADVISORY COURSES

127

SECOND SEMESTER.

| | | |
|------------|--------------------------------------|-------|
| Pet. 2 | Microscopical Mineralogy | 2 |
| Pet. 10 | Petrographical Laboratory | 2 |
| Geol. 8 | Stratigraphical Geology | 2 |
| Geol. 10 | Physical and Chemical Geology | 2 |
| Geol. 14 | Paleozoic Geology | 2 |
| M. Geol. 4 | Building and Ornamental Stones | 2 |
| M. Geol. 6 | Metallites or Metalliferous Deposits | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| 7b | Ethics | 2 |
| 175 | Calculus | 3 |
| 176 | Analytic Mechanics | 4 |
| | | <hr/> |
| | | 25 |

JUNIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|-------------|---|---------|
| Pet. 3 | Microscopical Petrography | 2 |
| Pet. 11 | Petrographical Laboratory | 2 |
| Met. 68 | Fire Assaying | 2 |
| Geol. 15 | Mesozoic and Cenozoic Geology | 2 |
| Geol. 17 | Glacial Geology | 2 |
| M. Geol. 7 | Ore Deposits of the United States | 2 |
| M. Geol. 16 | Coal—Its Origin, Occurrence, etc. | 2 |
| M. Geol. 22 | Iron and Manganese Ores | 2 |
| Mine. 38 | Hydraulic Mining and Dredging | 2 |
| Law 1 | Principles of Law and Mining Law | 2 |
| 61 | Economics | 2 |
| 64 | Modern Industries and Industrial Management | 2 |
| 285 | Mechanics of Materials | 2 |
| | | <hr/> |
| | | 26 |

SECOND SEMESTER.

| | | |
|-------------|-----------------------------------|---|
| Pet. 4 | Microscopical Petrography | 2 |
| Pet. 12 | Petrographical Laboratory | 2 |
| Geol. 16 | Mesozoic and Cenozoic Geology | 2 |
| Geol. 18 | Glacial Geology | 2 |
| M. Geol. 8 | Ore Deposits of the United States | 2 |
| M. Geol. 17 | Coal—Its Origin, Occurrence, etc. | 2 |
| M. Geol. 23 | Iron and Manganese Ores | 2 |
| Mine. 39 | Hydraulic Mining and Dredging | 2 |
| Law 2 | Mining Law and Mining Injuries | 2 |

| | | |
|-----|--------------------------------|-------|
| 33 | General Psychology | 2 |
| 65 | Corporation Finance | 2 |
| 286 | Hydro-Mechanics and Hydraulics | 3 |
| | | <hr/> |
| | | 25 |

SENIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|-------------|--|---------|
| Pet. 5 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 13 | Petrographical Laboratory | 2 |
| Geol. 11 | Azoic or Archæan Geology | 2 |
| Geol. 19 | Prehistoric Man | 2 |
| Geol. 21 | Geology of the United States | 2 |
| M. Geol. 14 | Precious Stones or Gems | 2 |
| M. Geol. 18 | Petroleum, Natural Gas, etc. | 2 |
| M. Geol. 26 | Copper Deposits | 2 |
| M. Geol. 28 | Gold, Silver, and Silver Lead Deposits | 2 |
| M. Geol. 36 | Genesis of Ore Deposits | 2 |
| Mine. 29 | Mine Prospecting, Sampling, Valuation, etc. | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, Care, etc. | 2 |
| | | <hr/> |
| | | 26 |

SECOND SEMESTER.

| | | |
|-------------|---|-------|
| Pet. 6 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 14 | Petrographical Laboratory | 2 |
| Geol. 12 | Azoic or Archæan Geology | 2 |
| Geol. 20 | Prehistoric Man | 2 |
| Geol. 22 | Geology of the United States | 2 |
| M. Geol. 15 | Precious Stones or Gems | 2 |
| M. Geol. 19 | Petroleum, Natural Gas, etc. | 2 |
| M. Geol. 27 | Copper Deposits | 2 |
| M. Geol. 29 | Gold, Silver, and Silver Lead Deposits | 2 |
| M. Geol. 37 | Genesis of Ore Deposits | 2 |
| Mine. 30 | Mine Accidents—Causes and Prevention | 2 |
| Mine. 31 | Mine Explosives—Care and Use | 2 |
| Mine. 34 | Mine Labor, Strikes, Legislation, etc. | 2 |
| | | <hr/> |
| | | 26 |

BACHELOR OF SCIENCE IN CERAMICS

FRESHMAN YEAR

FIRST SEMESTER.

| NUMBER | SUBJECT | CREDITS |
|------------|--|----------|
| Min. 1 | Crystallography and Mineralogy | 6 |
| Geol. 5 | General Geology | 2 |
| Geol. 7 | Biological Geology | 2 |
| Geol. 47 | Field Geology and Geological Surveying and Mapping | 2 |
| M. Geol. 1 | Mining Geology | 2 |
| 169 | Trigonometry | 3 |
| 185 | Chemistry | 5 |
| 194 | Chemical Calculations | 1 |
| 370 | Mechanical Drawing | 2 |
| | | <hr/> 26 |

SECOND SEMESTER.

| | | |
|------------|--|----------|
| Min. 2 | Mineralogy and Petrography | 6 |
| Geol. 6 | Structural and Field Geology | 2 |
| Geol. 8 | Stratigraphical Geology | 2 |
| Geol. 48 | Field Geology and Geological Surveying and Mapping | 2 |
| M. Geol. 2 | Mining Geology | 2 |
| 7b | Ethics | 2 |
| 172 | Surveying | 3 |
| 186 | Qualitative Analysis | 3 |
| 194 | Chemical Calculations | 1 |
| 371 | Mechanical Drawing | 2 |
| | | <hr/> 25 |

SOPHOMORE YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|--------------------------------------|---------|
| Pet. 1 | Microscopical Mineralogy | 2 |
| Pet. 9 | Petrographical Laboratory | 2 |
| M. Sur. 1 | Mine Surveying | 2 |
| Met. 1 | Principles of Metallurgy | 2 |
| Met. 2 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 4 | Furnaces, Refractory Materials, etc. | 2 |
| M. Geol. 9 | Clays—Their Origin, Occurrence, etc. | 2 |
| Cer. 1 | Clay Testing | 2 |

| NUMBER | SUBJECT | CREDITS |
|---------|--------------------------------------|----------|
| Cer. 3 | Bricks, Tiles, Terra Cotta, etc. | 2 |
| Cer. 21 | Ceramic Laboratory | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| 187 | Quantitative Analysis | 3 |
| | | <hr/> 25 |

SECOND SEMESTER

| | | |
|-------------|--------------------------------------|----------|
| Pet. 2 | Microscopical Mineralogy | 2 |
| Pet. 10 | Petrographical Laboratory | 2 |
| Met. 3 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 5 | Furnaces, Refractory Materials, etc. | 2 |
| M. Geol. 4 | Building and Ornamental Stones | 2 |
| M. Geol. 10 | Clays—Their Origin, Occurrence, etc. | 2 |
| M. Geol. 13 | Materials for Glazes, etc. | 2 |
| Cer. 2 | Clay Mining and Manufacture | 2 |
| Cer. 4 | Bricks, Tiles, Terra Cotta, etc. | 2 |
| Cer. 21 | Ceramic Laboratory | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| 187 | Quantitative Analysis | 3 |
| | | <hr/> 25 |

JUNIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|-------------|--|----------|
| Pet. 3 | Microscopical Petrography | 2 |
| Pet. 11 | Petrographical Laboratory | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| M. Geol. 11 | Lime, Plaster, and Cement Materials | 2 |
| Cer. 5 | Limes, Plasters, and Cements | 2 |
| Cer. 7 | Glazes, Enamels, and Colors | 2 |
| Cer. 9 | Manufacture of Glass, etc. | 2 |
| Cer. 11 | Ceramic Calculations | 2 |
| Cer. 17 | Fire Brick—Manufacture, Properties, etc. | 2 |
| Cer. 29 | Ceramic Laboratory | 2 |
| Mine. 17 | Mine Management, Accounts, Supplies, Purchases, Sales, etc. | 2 |
| Law 1 | Principles of Law and Mining Law | 2 |
| | | <hr/> 24 |

SECOND SEMESTER

| | | |
|-------------|-------------------------------------|---|
| Pet. 4 | Microscopical Petrography | 2 |
| Pet. 12 | Petrographical Laboratory | 2 |
| M. Geol. 11 | Lime, Plaster, and Cement Materials | 2 |

ADVISORY COURSES

131

| NUMBER | SUBJECT | CREDITS |
|----------|--|---------|
| Cer. 5 | Limes, Plasters, and Cements | 2 |
| Cer. 8 | Glazes, Enamels, and Colors | 2 |
| Cer. 10 | Manufacture of Glass | 2 |
| Cer. 12 | Ceramic Construction | 2 |
| Cer. 14 | Cements—Their Manufacture, etc. | 2 |
| Cer. 18 | Manufacture of Sand-Lime-Brick, etc. | 2 |
| Cer. 30 | Ceramic Laboratory | 2 |
| Mine. 18 | Mine Management, Accounts, Supplies, Purchases, Sales, etc. | 2 |
| Law 2 | Mining Law and Mining Injuries | 2 |
| 69 | Business Law | 2 |
| | | 26 |

SENIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|----------|--|---------|
| Cer. 15 | Concrete—Its Properties, etc. | 2 |
| Cer. 19 | Manufacture of Pottery and Porcelain | 2 |
| Cer. 25 | Ceramic Laboratory | 2 |
| Mine. 29 | Mine Prospecting, Sampling, Valuation, etc. | 2 |
| Mine. 31 | Mine Explosives—Care and Use | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, Care, etc. | 2 |
| 60 | Political Economy | 3 |
| 62 | Money and Banking | 2 |
| 63 | Transportation | 2 |
| 64 | Modern Industries and Industrial Management | 2 |
| 70 | Sociology | 3 |

SECOND SEMESTER

| | | |
|----------|---|----|
| Cer. 16 | Concrete Construction | 2 |
| Cer. 20 | Manufacture of Pottery and Porcelain | 2 |
| Cer. 26 | Ceramic Laboratory | 2 |
| Mine. 30 | Mine Accidents—Causes, Prevention, etc. | 2 |
| Mine. 31 | Mine Explosives—Care and Use | 2 |
| Mine. 34 | Mine Labor, Strikes, Legislation, etc. | 2 |
| 33 | General Psychology | 2 |
| 60 | Political Economy | 3 |
| 62 | Money and Banking | 2 |
| 65 | Corporation Finance | 2 |
| 70 | Sociology | 3 |
| 297 | Contracts and Specifications | 2 |
| | | 26 |

SCHOOL OF MINES

MINING

FRESHMAN YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|--|----------|
| Min. 1 | Crystallography and Mineralogy | 6 |
| Geol. 5 | General Geology | 2 |
| Geol. 7 | Biological Geology | 2 |
| Geol. 47 | Field Geology and Geological Surveying and Mapping | 2 |
| M. Geol. 1 | Mining Geology | 2 |
| 169 | Trigonometry | 3 |
| 185 | Chemistry | 5 |
| 194 | Chemical Calculations | 1 |
| 370 | Mechanical Drawing | 2 |
| | | <hr/> 25 |

SECOND SEMESTER

| | | |
|------------|--|----------|
| Min. 2 | Mineralogy and Petrography | 6 |
| Geol. 6 | Structural and Field Geology | 2 |
| Geol. 8 | Stratigraphical Geology | 2 |
| Geol. 48 | Field Geology and Geological Surveying and Mapping | 2 |
| M. Geol. 2 | Mining Geology | 2 |
| 7b | Ethics | 2 |
| 172 | Surveying | 3 |
| 186 | Qualitative Analysis | 3 |
| 194 | Chemical Calculations | 1 |
| 371 | Mechanical Drawing | 2 |
| | | <hr/> 25 |

SOPHOMORE YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|---|---------|
| Pet. 1 | Microscopical Mineralogy | 2 |
| Pet. 9 | Petrographical Laboratory | 2 |
| M. Sur. 1 | Mine Surveying | 2 |
| Met. 1 | Metallurgy | 2 |
| Met. 68 | Fire Assaying | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| M. Geol. 3 | Metalliferous or Non-Metalliferous Deposits | 2 |
| M. Geol. 5 | Metalliferous or Non-Metalliferous Deposits | 2 |

ADVISORY COURSES

133

| NUMBER | SUBJECT | CREDITS |
|----------|--------------------------------------|---------|
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| Mine. 44 | Mining Laboratory and Design | 2 |
| 60 | Political Economy | 3 |
| 187 | Quantitative Analysis | 3 |

26

SECOND SEMESTER

| | | |
|------------|---|---|
| Pet. 2 | Microscopical Petrography | 2 |
| Pet. 10 | Petrographical Laboratory | 2 |
| M. Sur. 2 | Mine Surveying | 2 |
| Met. 69 | Fire Assaying | 2 |
| Ore. 2 | Ore Dressing Operations and Machinery | 2 |
| Ore. 7 | Coal Washing and Preparation for the Market | 2 |
| M. Geol. 4 | Building and Ornamental Stones | 2 |
| M. Geol. 6 | Metallites or Metalliferous Deposits | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| Mine. 45 | Mining Laboratory | 2 |
| 60 | Political Economy | 3 |
| 187 | Quantitative Analysis | 3 |

25

JUNIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|---|---------|
| Pet. 3 | Microscopical Petrography | 2 |
| Pet. 11 | Petrographical Laboratory | 2 |
| M. Geol. 7 | Ore Deposits of the United States | 2 |
| Mine. 5 | Coal Mining | 2 |
| Mine. 7 | Metal Mining | 2 |
| Mine. 13 | Mine Gases, Ventilation, etc. | 2 |
| Mine. 17 | Mine Management, Accounts, Supplies, etc. | 2 |
| Mine. 46 | Mining Laboratory and Design | 2 |
| Mine. 65 | Electricity Applied to Mining | 2 |
| Law 1 | Principles of Law and Mining Law | 2 |
| 64 | Modern Industries and Industrial Management | 2 |
| 70 | Sociologic Theory | 3 |

25

SECOND SEMESTER

| | | |
|------------|-----------------------------------|---|
| Pet. 4 | Microscopical Petrography | 2 |
| Pet. 12 | Petrographical Laboratory | 2 |
| M. Geol. 8 | Ore Deposits of the United States | 2 |
| Mine. 6 | Coal Mining | 2 |

SCHOOL OF MINES

| NUMBER | SUBJECT | CREDITS |
|----------|---------------------------------|---------|
| Mine. 8 | Metal Mining | 2 |
| Mine. 14 | Mine Gases, Ventilation, etc. | 2 |
| Mine. 18 | Mine Management, Accounts, etc. | 2 |
| Mine. 47 | Mining Laboratory and Design | 2 |
| Mine. 66 | Electricity Applied to Mining | 2 |
| Law 2 | Mining Law and Mining Injuries | 2 |
| 33 | General Psychology | 2 |
| 70 | Sociologic Theory | 3 |
| | | <hr/> |
| | | 25 |

SENIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|-------------|---|---------|
| Pet. 5 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 13 | Petrographical Laboratory | 2 |
| M. Geol. 36 | Genesis of Ore Deposits | 2 |
| Mine. 15 | Laying Out of Mines and Mine Plants | 2 |
| Mine. 29 | Mine Prospecting, Sampling, Valuation, etc. | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, etc. | 2 |
| Mine. 48 | Mining Laboratory and Design | 2 |
| 62 | Money and Banking | 2 |
| 63 | Transportation | 2 |
| 306 | Engines and Boilers | 3 |
| 320a | Engine and Boiler Testing | 1 |
| | | <hr/> |
| | | 24 |

SECOND SEMESTER

| | | |
|-------------|---|---|
| Pet. 6 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 14 | Petrographical Laboratory | 2 |
| M. Geol. 37 | Genesis of Ore Deposits | 2 |
| Mine. 16 | Laying Out of Mines and Mine Plants | 2 |
| Mine. 30 | Mine Accidents—Causes, Prevention, etc. | 2 |
| Mine. 34 | Mine Labor, Strikes, Legislation, etc. | 2 |
| Mine. 49 | Mining Laboratory and Design | 2 |
| 62 | Money and Banking | 2 |
| 65 | Corporation Finance | 2 |
| 69 | Business Law | 2 |
| 294 | Roads and Pavements | 2 |
| 297 | Contracts and Specifications | 2 |

MINING GEOLOGY

FRESHMAN YEAR

Same as that for the Bachelor of Science in Mining.

SOPHOMORE YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|--|---------|
| Pet. 1 | Microscopical Mineralogy | 2 |
| Pet. 9 | Petrographical Laboratory | 2 |
| M. Sur. 1 | Mine Surveying | 2 |
| Met. 1 | Principles of Metallurgy | 2 |
| Met. 68 | Fire Assaying | 2 |
| Geol. 9 | Physical and Chemical Geology | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| M. Geol. 3 | Metallites or Non-Metalliferous Deposits | 2 |
| M. Geol. 5 | Metallites or Metalliferous Deposits | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| Mine. 44 | Mining Laboratory and Design | 2 |
| 187 | Quantitative Analysis | 3 |

 25

SECOND SEMESTER

| | | |
|------------|---|---|
| Pet. 2 | Microscopical Mineralogy | 2 |
| Pet. 10 | Petrographical Laboratory | 2 |
| M. Sur. 2 | Mining Surveying | 2 |
| Geol. 10 | Physical and Chemical Geology | 2 |
| Ore. 2 | Ore Dressing Operations and Machinery | 2 |
| Ore. 7 | Coal Washing and Preparation for the Market | 2 |
| M. Geol. 4 | Building and Ornamental Stones | 2 |
| M. Geol. 6 | Metallites or Metalliferous Deposits | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| Mine. 45 | Mining Laboratory and Design | 2 |
| 33 | General Psychology | 2 |
| 187 | Quantitative Analysis | 3 |

 25

JUNIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|-------------|-----------------------------------|---------|
| Pet. 3 | Microscopical Petrography | 2 |
| Pet. 11 | Petrographical Laboratory | 2 |
| M. Geol. 7 | Ore Deposits of the United States | 2 |
| M. Geol. 16 | Coal—Its Origin, Occurrence, etc. | 2 |

SCHOOL OF MINES

| NUMBER | SUBJECT | CREDITS |
|-------------|----------------------------------|---------|
| M. Geol. 23 | Iron and Manganese Ores | 2 |
| Mine. 5 | Coal Mining | 2 |
| Mine. 7 | Metal Mining | 2 |
| Mine. 38 | Hydraulic Mining and Dredging | 2 |
| Law 1 | Principles of Law and Mining Law | 2 |
| 60 | Political Economy | 3 |
| 188 | Quantitative Analysis | 3 |

 24

SECOND SEMESTER

| | | |
|-------------|-----------------------------------|---|
| Pet. 4 | Microscopical Petrography | 2 |
| Pet. 12 | Petrographical Laboratory | 2 |
| M. Geol. 8 | Ore Deposits of the United States | 2 |
| M. Geol. 17 | Coal—Its Origin, Occurrence, etc. | 2 |
| M. Geol. 23 | Iron and Manganese Ores | 2 |
| Mine. 6 | Coal Mining | 2 |
| Mine. 8 | Metal Mining | 2 |
| Mine. 39 | Hydraulic Mining and Dredging | 2 |
| Law 2 | Mining Law and Mining Injuries | 2 |
| 60 | Political Economy | 3 |
| 188 | Quantitative Analysis | 3 |

 24

SENIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|-------------|---|---------|
| Pet. 5 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 13 | Petrographical Laboratory | 2 |
| M. Geol. 14 | Precious Stones or Gems | 2 |
| M. Geol. 18 | Petroleum, Natural Gas, etc. | 2 |
| M. Geol. 26 | Copper Deposits | 2 |
| M. Geol. 28 | Gold, Silver, and Silver Lead Deposits | 2 |
| M. Geol. 36 | Genesis of Ore Deposits | 2 |
| Mine. 29 | Mine Prospecting, Sampling, Valuation, etc. | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, etc. | 2 |
| 64 | Modern Industries and Industrial Management | 2 |
| 70 | Sociologic Theory | 3 |

 25

ADVISORY COURSES

137

SECOND SEMESTER

| | | |
|-------------|---|----|
| Pet. 6 | Origin of Minerals, Rocks, and Ore Deposits | 2 |
| Pet. 14 | Petrographical Laboratory | 2 |
| M. Geol. 15 | Precious Stones or Gems | 2 |
| M. Geol. 19 | Petroleum, Natural Gas, etc. | 2 |
| M. Geol. 27 | Copper Deposits | 2 |
| M. Geol. 29 | Gold, Silver, and Silver Lead Deposits | 2 |
| M. Geol. 37 | Genesis of Ore Deposits | 2 |
| Mine. 30 | Mine Accidents—Causes, Prevention, etc. | 2 |
| Mine. 31 | Mine Explosives—Care and Use | 2 |
| Mine. 34 | Mine Labor, Strikes, Legislation, etc. | 2 |
| 69 | Business Law | 2 |
| 70 | Sociologic Theory | 3 |
| | | 25 |

MINING LAW

FRESHMAN YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|--------------------------------|---------|
| Min. 1 | Crystallography and Mineralogy | 6 |
| Geol. 5 | General Geology | 2 |
| M. Geol. 1 | Principles of Mining Geology | 2 |
| 95 | Livy | 3 |
| 145 | Rhetoric and Composition | 3 |
| 169 | Trigonometry | 3 |
| 185 | Chemistry | 5 |
| 194 | Chemical Calculations | 1 |
| 370 | Mechanical Drawing | 2 |
| | | 27 |

SECOND SEMESTER

| | | |
|------------|------------------------------|----|
| Mine. 2 | Mineralogy and Petrography | 6 |
| Geol. 6 | Structural and Field Geology | 2 |
| M. Geol. 2 | Mining Geology | 2 |
| 96 | Cicero | 3 |
| 145 | Rhetoric and Composition | 3 |
| 148a | Public Speaking | 1 |
| 172 | Surveying | 3 |
| 186 | Qualitative Analysis | 3 |
| 194 | Chemical Calculations | 1 |
| 371 | Mechanical Drawing | 2 |
| | | 26 |

SCHOOL OF MINES

SOPHOMORE YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|--------------------------------------|----------|
| M. Sur. 1 | Mine Surveying | 2 |
| Met. 1 | Principles of Metallurgy | 2 |
| Met. 68 | Fire Assaying | 2 |
| Met. 74 | Wet Assaying | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| M. Geol. 5 | Metallites or Metalliferous Deposits | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| Mine. 44 | Mining Laboratory and Design | 2 |
| 60 | Political Economy | 3 |
| 70 | Sociology | 3 |
| 97 | Horace | 3 |
| | | <hr/> 25 |

SECOND SEMESTER

| | | |
|------------|--------------------------------------|----------|
| M. Sur. 2 | Mining Surveying | 2 |
| Met. 75 | Wet Assaying | 2 |
| M. Geol. 4 | Building and Ornamental Stones | 2 |
| M. Geol. 6 | Metallites or Metalliferous Deposits | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| Mine. 45 | Mining Laboratory and Design | 2 |
| 7b | Ethics | 2 |
| 33 | General Psychology | 2 |
| 60 | Political Economy | 3 |
| 70 | Sociology | 3 |
| 98 | Tacitus and Horace | 3 |
| | | <hr/> 25 |

JUNIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|-------------|-----------------------------------|---------|
| M. Geol. 7 | Ore Deposits of the United States | 2 |
| M. Geol. 16 | Coal—Its Origin, Occurrence, etc. | 2 |
| M. Geol. 22 | Iron and Manganese Ores | 2 |
| Mine. 5 | Coal Mining | 2 |
| Mine. 7 | Metal Mining | 2 |
| Mine. 13 | Mine Gases, Ventilation, etc. | 2 |
| Law 1 | Principles of Law and Mining Law | 2 |
| 10 | History of Philosophy | 3 |
| 62 | Money and Banking | 2 |

ADVISORY COURSES

139

| NUMBER | SUBJECT | CREDITS |
|--------|--------------------------|---------|
| 64 | Modern Industries, etc. | 2 |
| 69a | Principles of Accounting | 3 |
| 99 | Roman Law | 3 |

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SECOND SEMESTER

| | | |
|-------------|-----------------------------------|---|
| M. Geol. 8 | Ore Deposits of the United States | 2 |
| M. Geol. 16 | Coal—Its Origin, Occurrence, etc. | 2 |
| M. Geol. 22 | Iron and Manganese Ores | 2 |
| Mine. 5 | Coal Mining | 2 |
| Mine. 7 | Metal Mining | 2 |
| Mine. 13 | Mine Gases, Ventilation, etc. | 2 |
| Law 2 | Mining Law and Mining Injuries | 2 |
| 11 | History of Philosophy | 3 |
| 12 | Logic | 3 |
| 62 | Money and Banking | 2 |
| 69a | Principles of Accounting | 3 |
| 100 | Roman Law | 2 |

27

SENIOR YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|-------------|---|---------|
| M. Geol. 18 | Petroleum, Natural Gas, etc. | 2 |
| M. Geol. 26 | Copper Deposits | 2 |
| M. Geol. 28 | Gold, Silver, and Silver Lead Deposits | 2 |
| M. Geol. 36 | Genesis of Ore Deposits | 2 |
| Mine. 29 | Mine Prospecting, Sampling, Valuation, etc. | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, etc. | 2 |
| Law 3 | Advanced Mining Law | 2 |
| Law 5 | Law Relating to Oil and Gas | 2 |
| 29 | Systematic Psychology | 2 |
| 30 | Social Psychology | 2 |
| 63 | Transportation | 2 |
| 69b | Practical Accounting | 2 |

26

SECOND SEMESTER

| | | |
|-------------|---|---|
| M. Geol. 18 | Petroleum, Natural Gas, etc. | 2 |
| M. Geol. 27 | Copper Deposits | 2 |
| M. Geol. 29 | Gold, Silver, and Silver Lead Deposits | 2 |
| M. Geol. 37 | Genesis of Ore Deposits | 2 |
| Mine. 30 | Mine Accidents—Causes, Prevention, etc. | 2 |

| NUMBER | SUBJECT | CREDITS |
|----------|--|---------|
| Mine. 31 | Mine Explosives—Care and Use | 2 |
| Mine. 34 | Mine Labor, Strikes, Legislation, etc. | 2 |
| Law 4 | Advanced Mining Law | 2 |
| Law 6 | Law Relating to Oil and Gas | 2 |
| 59b | International Law | 2 |
| 65 | Corporation Finance | 2 |
| 69 | Business Law | 2 |
| 69b | Practical Accounting | 2 |

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SHORT COURSE IN MINING

Two Years

FIRST YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|--|---------|
| Min. 1 | Crystallography and Mineralogy | 6 |
| Geol. 5 | General Geology | 2 |
| Geol. 47 | Field Geology and Geological Surveying and Mapping | 2 |
| M. Geol. 1 | Principles of Mining Geology | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| 169 | Trigonometry | 3 |
| 185 | Chemistry | 5 |
| 194 | Chemical Calculations | 1 |
| 370 | Mechanical Drawing | 2 |

 25

SECOND SEMESTER

| | | |
|------------|---|---|
| Min. 2 | Mineralogy and Petrography | 6 |
| Geol. 6 | Structural and Field Geology | 2 |
| Geol. 48 | Field Geology, and Geological Surveying and Mapping | 2 |
| M. Geol. 2 | Principles of Mining Geology | 2 |
| M. Geol. 4 | Building and Ornamental Stones | 2 |
| Mine. 2 | Mining—Haulage, Hoisting, etc. | 2 |
| 172 | Surveying | 3 |
| 186 | Qualitative Analysis | 3 |
| 194 | Chemical Calculations | 1 |
| 371 | Mechanical Drawing | 2 |

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ADVISORY COURSES

141

SECOND YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|--------------|--|---------|
| M. Sur. 1 | Mine Surveying | 2 |
| Met. 1 | Metallurgy | 2 |
| Met. 68 | Fire Assaying | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| M. Geol. 3 | Metallites or Non Metalliferous Deposits | 2 |
| M. Geol. 5 | Metallites or Metalliferous Deposits | 2 |
| Mine. 5 or 7 | Coal Mining or Metal Mining | 2 |
| Mine. 13 | Mine Gases, Ventilation, etc. | 2 |
| Mine. 17 | Mine Management, Accounts, Supplies, Purchases, Sales, etc. | 2 |
| Mine. 29 | Mine Prospecting, Sampling, Valuation, etc. | 2 |
| Mine. 32 | First Aid to the Injured | 2 |
| Mine. 33 | Mine Labor, Strikes, Legislation, Care, etc. | 2 |
| Mine. 44 | Mining Laboratory and Design | 2 |

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SECOND SEMESTER

| | | |
|--------------|--|---|
| M. Sur. 2 | Mine Surveying | 2 |
| M. Geol. 6 | Metallites of Metalliferous Deposits | 2 |
| Mine. 6 or 8 | Coal Mining or Metal Mining | 2 |
| Mine. 14 | Mine Gases, Ventilation, etc. | 2 |
| Mine. 18 | Mine Management, Accounts, Supplies, Purchases, Sales, etc. | 2 |
| Mine. 30 | Mine Accidents—Causes, Prevention, etc. | 2 |
| Mine 34. | Mine Labor, Strikes, Legislation, Care, etc. | 2 |
| Mine. 49 | Mining Laboratory and Design | 2 |
| 7b | Ethics | 2 |
| 33 | General Psychology | 2 |
| 69 | Business Law | 2 |
| 297 | Contracts and Specifications | 2 |

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SHORT COURSE IN ASSAYING

Two Years

FIRST YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|----------|---|---------|
| Min. 1 | Crystallography and Mineralogy | 6 |
| Geol. 5 | General Geology | 2 |
| Geol. 47 | Field Geology and Geological Surveying and Mapping | 2 |

| NUMBER | SUBJECT | CREDITS |
|------------|--------------------------------------|---------|
| M. Geol. 1 | Principles of Mining Geology | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| 169 | Trigonometry | 3 |
| 185 | Chemistry | 5 |
| 194 | Chemical Calculations | 1 |
| 370 | Mechanical Drawing | 2 |

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SECOND SEMESTER

| | | |
|------------|---|---|
| Min. 2 | Mineralogy and Petrography | 6 |
| Geol. 6 | Structural and Field Geology | 2 |
| Geol. 48 | Field Geology, and Geological Surveying and Mapping | 2 |
| M. Geol. 2 | Principles of Mining Geology | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| 172 | Surveying | 3 |
| 186 | Qualitative Analysis | 3 |
| 194 | Chemical Calculations | 1 |
| 371 | Mechanical Drawing | 2 |
| 7b | Ethics | 2 |

 25

SECOND YEAR

FIRST SEMESTER

| NUMBER | SUBJECT | CREDITS |
|------------|---------------------------------------|---------|
| M. Sur. 1 | Mining Surveying | 2 |
| Met. 1 | Metallurgy | 2 |
| Met. 2 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 4 | Furnaces, Refractory Materials, etc. | 2 |
| Met. 13 | Metallography | 2 |
| Met. 40 | Metallurgical Laboratory | 2 |
| Met. 68 | Fire Assaying | 2 |
| Met. 74 | Wet Assaying | 2 |
| Ore. 1 | Ore Dressing and Coal Washing | 2 |
| M. Geol. 5 | Metallites or Metalliferous Deposits. | 2 |
| Mine. 1 | Mining—Exploitation, Timbering, etc. | 2 |
| 187 | Quantitative Analysis | 3 |

 25

SECOND SEMESTER

| | | |
|---------|--------------------------------------|---|
| Met. 3 | Fuels, Calorimetry, Pyrometry, etc. | 2 |
| Met. 5 | Furnaces, Refractory Materials, etc. | 2 |
| Met. 6 | Alloys, etc. | 2 |
| Met. 14 | Metallography | 2 |
| Met. 41 | Metallurgical Laboratory | 2 |

| NUMBER | SUBJECT | CREDITS |
|------------|--|----------|
| Met. 69 | Fire Assaying | 2 |
| Met. 75 | Wet Assaying | 2 |
| M. Geol. 6 | Metallites or Metalliferous Deposits | 2 |
| Mine. 2 | Mining—Hoisting, Haulage, etc. | 2 |
| Mine. 30 | Mine Accidents, Causes, Prevention, etc. | 2 |
| 187 | Quantitative Analysis | 2 |
| 297 | Contracts and Specifications | 2 |
| | | <hr/> 24 |

REGULATIONS OF THE SCHOOL OF MINES

PETITIONS

Every question formally presented to the School or to the Dean shall be in the form of a written petition, and every petition must have upon it the written approval of every officer directly concerned before presentation to the Dean of the School. If it is approved by the Dean, the petition is granted, and the Dean will so notify the student and all the parties concerned.

A student suspended or excluded from any class or the School for any cause, or by any rule, can only be restored under this regulation.

DISCIPLINE

No student shall be allowed to remain a member of the School or be connected with it in any way if his conduct shall be considered prejudicial to the interests of the School.

Any student who presents as his own the work of someone else, or who falsifies or cheats in any of his School relations, shall by that act stand dismissed from the School.

A student having conditions amounting to 9 credits at any time is by that fact dropped from the School.

A student standing dismissed by the instructors from two subjects at the same time, on account of absence, improper conduct, poor scholarship or from any other cause, becomes by that fact dismissed from the School.

INSTRUCTORS

Each instructor is the sole judge of the fitness of every student taking his subjects. He may refuse to admit into his class any student found deficient in preparation, or dismiss him from his subject, after due warning, at any time when he has too many absences or when his conduct or work is unsatisfactory. Written information of this dismissal, and the reason therefor, shall at once be sent to the Dean.

Each instructor shall be charged with the personal supervision of the work in his subject or subjects, and shall inform the student, upon his request, from time to time of his status.

Each instructor has charge of the absences, conduct, and work of the students when in his class, and he shall keep a record of the absences, and the work of each student under his charge.

No instructor will be retained unless he maintains good order in his class rooms and laboratories and proves himself an efficient teacher.

The grade and absences of a student shall be reported to the Dean of the School by each instructor at the end of each semester or when the subject has been concluded. The instructor may grade the student from his daily work or from examinations, or both, as seems best, but no student shall receive credit for any partially completed subject. The grades are also to be reported to the Registrar as provided in the College regulations.

EXAMINATIONS

An examination for the removal of a condition incurred in one Semester can be held only the next year, at the beginning of the Semester in which that subject is taught, except in the case of Seniors and Second Year Short Course Students. In the case of these men, the method and time of the removal of their conditions are to be arranged by means of petitions approved by the instructors concerned and the Dean, but all examinations in one subject are to be given at the same time.

Examinations are to be held, or not, at the end of the Semester or when the work is finished in each subject, as each instructor may decide, and for such part or all of his students as he directs.

CREDITS

Undergraduates and graduates of universities, colleges or other technical schools shall receive provisional credits for all work taken in the school from whence they come, for which they present the proper credits and which are the apparent equivalents of subjects taught in this School. If, after a suitable length of time, the student proves his work to have been the equivalent of the work required in this School, his provisional credits shall become permanent, and each instructor concerned shall so certify to the Dean of the School and to the Registrar. Otherwise the student shall receive no credit for work done in other institutions.

CHOICE OF ELECTIVES OR OPTIONS

Triplicate lists of the required studies and electives chosen are to be handed to the Dean by every student as follows:

For First Semester: On or before May 15.

For Second Semester: On or before December 15.

For Summer Vacation: On or before May 15.

After the subjects have been chosen for the Semester or Summer Vacation a student can change, drop or take up any study, either elective or required, only in the following manner: He is to hand to the Dean a written request, stating the change desired and the reason therefor. This petition, before it is placed in the Dean's hands, is to bear the written approval of each and every instructor affected by the proposed change. If it shall then be approved by the Dean, the change may be made, and the Dean shall notify the student and the instructors concerned.

Further, the work already done in the subject from which the change is made will not be counted, but the student will be obliged to complete all the required work in the subject to which he is transferred, the same as if the latter subject had been originally chosen.

Any student failing to hand in to the Dean triplicate lists of his studies, both required and elective, by the time specified, or who drops or takes up any study except in the manner here stated, is by that fact suspended from all exercises in the School until he is reinstated by petition in the manner specified.

Each student must show to each of his instructors a schedule for that Semester, signed by the Dean, before any instructor is to admit that student to his class.

Subjects are to be taken in sequence, but not necessarily in any specified year.

In exceptional cases, a student may be allowed by the Dean to take a subject out of sequence, if the student presents a petition giving the reasons therefor, and bearing the written approval of the instructors in the preparatory subjects and the instructor in the subject to be taken.

GRADUATE STUDENTS

Students who have received a Bachelor of Science or an Engineering Degree in this School, or in one whose course can be accepted as an equivalent, will be admitted to pursue graduate studies.

The courses may be selected from the graduate and undergraduate subjects, under the direction of the Dean and the instructors concerned.

EXPENSES

PER SEMESTER

| | |
|--|---------|
| Matriculation Fee (at entrance only)..... | \$ 5.00 |
| Tuition | 50.00 |
| Chemistry | 10.00 |
| Mineralogical Laboratory, each hour a week..... | 2.00 |
| Electrical Laboratory | 10.00 |
| Biological Laboratory | 10.00 |
| Assaying, each hour a week..... | 2.00 |
| Ore Dressing Laboratory, each hour a week..... | 2.00 |
| Petrographical Laboratory, each hour a week..... | 2.00 |
| Metallurgical Laboratory, each hour a week..... | 2.00 |
| Ceramic Laboratory, each hour a week..... | 2.00 |
| Laboratory of Mining Geology, each hour a week..... | 2.00 |
| Field Geology and Geological Laboratory, each hour a week..... | 1.00 |
| Mining Laboratory, each hour a week..... | 1.00 |
| Mining Surveying, each hour a week..... | 2.00 |
| Paleontological Laboratory, each hour a week..... | 2.00 |
| Paleobotanical Laboratory, each hour a week..... | 2.00 |
| Hydro-Metallurgical Laboratory, each hour a week..... | 4.00 |
| Electro-Metallurgical Laboratory, each hour a week..... | 4.00 |
| Metallography, each hour a week..... | 2.00 |
| Crystallographic Laboratory, each hour a week..... | 2.00 |
| Shopwork | 10.00 |
| Breakage deposit required of all students taking Laboratory or shopwork | 10.00 |
| Gymnasium Fee | 2.50 |
| Diploma Fee, at graduation..... | 5.00 |
| Athletic Fee (per year)..... | 5.00 |

REGISTER OF STUDENTS

1907-1908

SENIOR CLASS

Blackburn, Harry Alfred

Oakmont

JUNIOR CLASS

Kramer, Bernard

Pittsburgh

Zieg, Waldemar William

Ross Township

SOPHOMORE CLASS

Lewis, Reed Morrison

West Etna

FRESHMAN CLASS

| | |
|-------------------------|------------|
| Hall, Daniel Williams | Pittsburgh |
| MacLeod, James Thompson | Wilksburg |
| Mohler, Karl Irvin | Freedom |
| Peters, Charles Meade | Ben Avon |
| Total number | 8 |

1908-1909

GRADUATE STUDENTS

| | |
|---|------------|
| Acker, Louis Kossuth, Jr., E. M., University of Pittsburgh | Pittsburgh |
| Carson, John Robb, B. S., Princeton University | Sewickley |
| Farrington, Ray Philip, B. S., The Pennsylvania State College | Pittsburgh |
| Fischer, William Frederick, E. M., University of Pittsburgh | Pittsburgh |

SENIOR CLASS

| | |
|---------------------------|--------------|
| Haldeman, George Thompson | Thompsontown |
| Kramer, Bernard | Pittsburgh |
| Williams, Roy Morrison | New Castle |

JUNIOR CLASS

| | |
|---------------------------|---------------|
| Cole, Walter Ray | Beaver Falls |
| Cosgrove, Paul Brown, Jr. | Hastings |
| Lewis, Reid Morrison | West Etna |
| Zieg, Waldemar William | Ross Township |

SOPHOMORE CLASS

| | |
|----------------------------|------------------|
| Bishoff, Avery | Rankin |
| Crea, James Harrison | Mars |
| Estabrook, Ned Lewis | Plattville, Wis. |
| Humphries, William Howard | Vance's Mills |
| MacLeod, James Thompson | Wilksburg |
| Mohler, Karl Irvin | Freedom |
| Peters, Charles Meade | Ben Avon |
| Zimmerman, James Zechariah | Delmont |

FRESHMAN CLASS

| | |
|------------------------|-----------------|
| Fleming, James Russell | Peale |
| Golden, Robert Gerrit | Pittsburgh |
| Keller, James Blake | Scottdale |
| Som, Apurra Kumar | Calcutta, India |
| Wynne, Ira Harold | Glen Willard |
| Yost, Raymond George | Pittsburgh |

SCHOOL OF MINES

FIRST YEAR, SHORT COURSE

Mitchell, Donald Worrell

Plains

SPECIAL STUDENTS

Allen, William Lloyd

North Side, Pittsburgh

Brenneman, Robert Carl

Pottsville

Daubenspeck, Charles Vincent

Cochranon

Freeman, Mitchell

Pittsburgh

McTurk, Morton Harrison

Philadelphia

Reith, August

Pittsburgh

Ressler, Elmer Bruce

Pittsburgh

Ross, Harry Earle

North Side, Pittsburgh

Total number

34

Yearly Attendance since the School of Mines was Established.

| | 1895-6 | 1896-7 | 1897-8 | 1898-9 | 1899-1900 | 1900-01 |
|-----------|---------|---------|---------|---------|-----------|---------|
| Students | 0 | 5 | 4 | 3 | 5 | 3 |
| Graduates | | | | | | |
| | 1901-02 | 1902-03 | 1903-04 | 1904-05 | 1905-06 | 1906-07 |
| Students | 1 | 4 | 3 | 2 | 9 | 7 |
| Graduates | 1 | 0 | 0 | 0 | 2 | 2 |
| | 1907-08 | 1908-09 | | | | |
| Students | 8 | 34 | | | | |
| Graduates | 1 | 2 | | | | |

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